SYSTEMS AND PROCEDURES QUARTERLY

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SPECIAL ISSUE

The Association's Report to Industry

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Business Survival in the face of Atomic Attack

by Mervyn Molloy

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PUBLISHED BY THE SYSTEMS AND PROCEDURES ASSOCIATION OF AMERICA

Code of Ethics

As a member of this organization, I recognize that I have an obligation:

To promote the advancement of systems and procedures throughout all management. I shall uphold the standards of our Association and cooperate with others in the dissemination of knowledge on developments in our field.

To my employer and my fellow member whose trust I hold. I will endeavor to the best of my ability to warrant this confidence by advising them wisely and honestly.

Not to use my membership in this Association as an advertisement to solicit business with clients.

Not to accept commissions for the sale of equipment to my employer or my clients.

Not to use any knowledge gained of the internal conditions of the business of a fellow member's employer to further my own personal interests with that company or discredit the fellow member before his employer.

I accept membership in this Association with a full knowledge of the responsibility it imposes upon me and I shall dedicate myself to the discharge of these obligations.

". . . to provide a means for the study and dissemination of knowledge relative to systems and procedures through research, discussion and publications"

—from the Association's By-Laws

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October 1952

An Important Conference

IN the brief span of years that International Systems Meetings have been taking place, their subscribers have come to recognize them as working meetings—occasions when the systems man or woman can obtain orientation on an unfamiliar facet of methods work either through the presentation of prepared papers, or by the casual exchange of ideas with one's colleagues. Add the consideration of one's ability to form lasting friendships in the sphere of methods work, and one is even more impressed with the value of this conference.

Meetings such as these are not developed over night but represent months of preparation and hard work. Committees devote much time to a variety of matters designed to produce a well balanced program in proper surroundings, with loss of sleep, upset stomachs and frayed tempers the usual reward for the effort.

The only real compensation to these hard-working members comes on registration day with the sight of methods men and women present in large numbers. The reward increases with evidence of appreciative audiences. Such circumstances generally indicate a financial success which, of course, is important to SPA.

The Fifth International Systems Meeting will take place the days of October 20, 21 and 22 at the Roosevelt Hotel in New York. Its committees have prepared an attractive program—one worthy of attendance by everyone interested in systems work. Those of us who attend the meeting will remember the speakers and their subjects long after we have again become absorbed in our own business problems—perhaps to the benefit of some of those problems. All systems people will be extended the hand of welcome at this great meeting next month.

The Research Project—

Business Survival in the Face of Atomic Attack

was initiated during the 1950-51 Fiscal year of the Association under the direction of its

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The Association's Research Project

General Hoyt S. Vandenburg, Chief of Staff, United States Air Force, has said, *at most only 30 per cent of the enemy bombers making an attack in strength on the United States would be stopped by our air force.* The balance would get through to destroy our homes and industrial centers.

The implications of that statement are sweeping. No one knows for certain whether we will be attacked by air, but the possibility exists. And American industry cannot be caught flatfooted.

If an attack comes, buildings, plants, and equipment may be destroyed. People may be lost. Production may be crippled or entirely knocked out for a perilously long time.

Europe and World War II taught us that despite enemy action production can be maintained at reasonably high levels *IF* effective defense measures have been worked out and installed.

Business Has A Responsibility

The billions appropriated for defense are largely aimed at strengthening our army, naval, and air forces. Expenditures for civilian defense are comparatively small.

Industrial or business defense is outside the scope of government action. Industry, itself, must take the initiative to protect its own people and operations. Our government naturally is eager to help, but survival of business is the responsibility of business.

Making industry defense-conscious is management's job. Large businesses will use over 40 professional specialties to put teeth in an industrial defense program. Small businesses will call on a proportionately smaller group. But any plan of action is company-wide, and management must approach defense as it would any company-wide business problem.

What This Report To Industry Covers

This *Report* is prepared to coach companies in planning, organizing, and administering industrial defense programs. Our objective is to translate into business people's language and thinking the many technical aspects of this problem.

What should the president know and do? Where do the chief engineer, purchasing agent, controller, personnel head, and auditor fit in? What is the role of each of our supervisors, and how is it made clear and effective? What can the systems man do to coordinate inter-departmental planning?

This is not a detailed plan. Each company's procedures must be tailored to satisfy its own needs. This *Report* does point out, however, the strategic areas where plans and procedures must be developed—and how that job can be done.

Why SPA Entered Industrial Defense Planning

SPA's purpose is to study and disseminate knowledge pertinent to systems and procedures. That job logically leads to organization and managerial planning. A problem affecting our entire management indisputably affects the systems man.

As members of SPA, we are anxious to share in this special planning as a management service to our companies. As a professional association, we want to serve both the people and industry of America.

What SPA Has Done

In beginning research on this problem we reviewed over 1100 publications. They represented the best efforts of technical specialists in federal, state, and local governments, in trade associations and business organizations, and research foundations. Many are excellent and have been listed in this report's bibliography.

But what we wanted to end up with was a planning guide for business which would give the entire story in plain talk. We wanted to work up something management could sink its teeth into and say, "This is it!"

SPA set about preparing such a guide. It wasn't easy. The research job alone was tremendous—requiring many months of persevering effort by men already employed full-time. This problem was solved by engaging Mr. Mervyn Molloy, consultant on management research and industrial defense.

Mr. Molloy prepared this *Report to Industry* which we proudly release as a special issue of Systems and Procedures Quarterly.

How This Report Helps Industry

By publishing this Report to Industry, SPA hopes to give

(1) *business executives* a quick grasp of the overall problem from the view of top management, with an eye to improving or initiating industrial defense;

(2) *members of SPA* a broad understanding of industrial defense so they may co-pilot management's efforts toward defense;

(3) *other associations and research groups* basic information for undertaking programs in their particular specialties;

Support Of Governmental Agencies

Federal and state authorities who reviewed this *Report to Industry* were generous in their compliments. We sincerely hope industry will feel the same and recognize it as the valuable service we think it is.

REPORT TO INDUSTRY

Business Survival

in the face of

Atomic Attack

by

MERVYN MOLLOY

Director, INDUSTRIAL DEFENSE INSTITUTE

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The author gratefully acknowledges the cooperation of the numerous individuals and organizations whose assistance made it possible for this Report finally to become a reality. Particular acknowledgment is made of the exceptional encouragement and technical guidance given by the staff of the New York State Civil Defense Commission.

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Part 1

DIMENSIONS OF THE PROBLEM

CHAPTER I

THE EVER-PRESENT DANGER

THE PURPOSE of this *Report to Industry* is to supply business executives with basic information on their new and serious responsibility of organizing the defense of the American industrial plant against large-scale, unannounced atomic attacks by long-range bombers from Soviet Russia.

The structure of reasoning in this *Report* is based on the following premises:

(1) that the philosophy and program of the International Communist Party calls for the destruction of free enterprise capitalism throughout the world;

(2) that the Communist Party in Russia has been organizing the industrial and military resources of that nation since 1917 for the purpose of spreading communist control over other nations;

(3) that World War II demonstrated that the Soviet Union has the military power necessary to fight and win a modern war, and to extend the influence of communism over other nations through military force;

(4) that Soviet spokesmen have stated unequivocally that the United States is now the leading opponent of world communism;

(5) that Russia maintains a military force-in-being so large that it can be explained strategically only in terms of offensive warfare;

(6) that this country must organize sufficient military power to withstand or discourage possible Soviet attack, and that such military power is absolutely dependent on the production of American industrial plants;

(7) that Russia now possesses a sizeable stockpile of atomic bombs and long-range bombing planes capable of striking a paralyzing blow on industrial centers in the United States;

(8) that 70% or more of the bombers in an aerial armada reaching Continental United States could get past our military air defenses and reach American cities;

(9) that well-organized civil defense is the only protection against potentially tremendous damage to American citizens and to the industrial plant on which our capacity to launch a full-scale counter-attack depends;

(10) that defense of industry against atomic attack must be considered as an integral part of the national civil defense program;

(11) that the federal government as a matter of policy holds owners and operators responsible for organizing defense of their establishments;

(12) that business management at this time needs technical information and orientation on the problem of organizing defense of their plants against atomic attack.

Soviet Intentions

In past wars, the rising storm was signalized in advance by many omens, and nations could accelerate defense preparations in accordance with the apparent imminence of hostilities. Even after the first shot was fired, standing armies and permanent defense works could hold the aggressors at bay for an indefinite period while the country mobilized its defensive resources. Only through successive battles could the enemy finally reach to the civilian heart of the country under attack.

Modern military technology has changed that picture completely. War may very well begin with no immediate danger signals and the first all-out attacks would most probably be aimed directly at heavily industrialized communities well within national borders.

As a result, cities and industrial plants anywhere in this country may find themselves without warning on the front lines of a murderous war. And civilian officials of such cities and business executives in such plants will

suddenly be faced with the awful responsibility of counteracting the local effects of warfare with only such resources as have been prepared in advance and are immediately available. The extent to which such advance preparations should be carried will depend on the probable nature, imminence and severity of the expected attacks.

In order that industrial leaders may begin to execute their planning responsibilities intelligently, it is essential first of all to have some appreciation of the *intentions* and *capabilities* of the enemy.

As it happens, we do not need any secret military information to understand the general intentions and strategy of potential Soviet attack on Continental United States. The Communist leaders themselves have set forth their plans with almost blinding clarity. However, in spite of their unmistakable declarations of intention to destroy our form of government and our way of a life, we Americans apparently find it difficult to believe that anyone could wish to tear down a social, political, and economic system which has produced such great material benefits for all classes of society. But such is the case.

In order to bring this point home to the American public, the House Committee on Foreign Affairs has published some of the most significant Communist documents in a volume entitled *The Strategy and Tactics of World Communism.* [22-4]* Let us look at a few key statements of leading Communist thinkers, government officials, and military planners which are particularly pertinent to the problem at hand.

Karl Marx and Friedrich Engels in the *Communist Manifesto* of 1848:

> The theory of Communism may be summed up in a single sentence: *Abolition of private property.*
>
> . . . the Communists everywhere support every revolutionary movement against the existing social and political order of things.
>
> The Communists disdain to conceal their views and aims. They openly declare their ends can be obtained only by forcible overthrow of all existing social conditions. Let the ruling classes tremble at a communistic revolution.

Lenin in 1915:

> To test the real power of a capitalist state, there is, and there can be, no other way than war.

Just two years later, in 1917, the Bolshevist minority seized the Russian government. This gave them at last a base of operations from which to extend their plans for world conquest.

Stalin in 1927:

> In the further progress of development of the international revolution, two world centers will be formed; the *socialist center*, attracting to itself all the countries gravitating toward socialism, and the *capitalist center*, attracting to itself all of the countries gravitating toward capitalism. The fight between these two centers for the conquest of world economy will decide the fate of capitalism throughout the whole world, for the final defeat of capitalism means the victory of socialism. . . .

Stalin, in 1938, quoting Lenin:

> . . . the existence of the Soviet Republic next to a number of imperialist States, for a long time is unthinkable. In the end, either the one or the other will have the better of it. Until that end comes, a series of most terrible conflicts between the Soviet Republic and the bourgeois States is inevitable.

Stalin, in 1946, speaking of World War II:

> Today we can say . . . that the Red Army . . . is a first class contemporary army with fully modern armament, highly experienced commanding personnel, and high moral and fighting qualities. It must not be forgotten that the Red Army is the army that utterly routed the German Army which but yesterday was striking terror into the armies of the European states.

Obviously by 1946 the Soviet felt confident that the internal structure of Russia could hold together even under the stress of war, and that it had a modern military force capable of conquering the armies of capitalist states.

Against whom was this Red Army being prepared to fight? We may find a possible answer in the words of Zhdanov, member of Politburo, in defining the post-war communist program to the Cominform in 1947:

> The war immensely enhanced the international significance and prestige of the U.S.S.R. . . .
>
> Instead of being enfeebled, the U.S.S.R. became stronger.
>
> The capitalist world has also undergone a substantial change. Of the six so-called great imperialist powers (Germany, Japan, Great Britain, the U. S. A., France and Italy), three have been eliminated by military defeat (Germany, Italy and Japan). France has also been weakened and has lost its significance as a great power. . . . The position of Great Britain has been undermined. . . . Britain was helpless against German aggression.
>
> Of all the capitalist powers, only one—the United States—emerged from the war not only unweakened but even considerably stronger, economically and militarily. . . .

*Numbers in brackets refer to source material as listed under corresponding numbers in SELECTED REFERENCES ON INDUSTRIAL DEFENSE.

> The fundamental changes caused by the war . . . have entirely changed the political landscape of the world. A new alignment of political forces has arisen . . . the principal driving force of the imperialist camp is the U. S. A.
>
> . . . the second camp is based on the U.S.S.R. and the new democracies.

How much clearer need language be?

Certainly, we must accept as a fundamental premise in our planning the fact that the Union of Soviet Socialist Republics has the intention of attacking the United States by force of arms if necessary as part of her long-standing plan to establish communism throughout the world, and that as long as this intention persists and can be carried out, we must be prepared to counteract the possible effects of such attack.

The Massing of Forces

After World War II, the Western Democracies demobilized their wartime armies, and turned to peaceful pursuits, relying on the United Nations to reconcile international differences without recourse to military action.

Not so the U.S.S.R. A very large armed force has been kept on a war footing, occupied countries have been drawn completely within the communist orbit, and new international tensions have been developed at many points.

Reliable sources indicate that the Soviet Union has the following forces available for combat:

> 4,000,000 men organized in 175 divisions plus 40 artillery divisions; 45 of these divisions are in East Germany and 30 in European Russia. (A U.S.S.R. division is composed of about 8,200 men compared with 18,400 in U. S. divisions.)
>
> 70 divisions in armies of the satellite countries
>
> 40,000 tanks
>
> 380 submarines
>
> 31,000 military planes in operation including jet fighters superior in quality to most of our own; ever-increasing numbers of two-and four-jet bombers; over 700 long-range bombers capable of delivering A-bombs to industrial centers in continental United States; flight-tested proto-types similar to our B-36 intercontinental heavy-bombers; annual military aircraft production of 17,000 planes.

Joseph and Stewart Alsop in their syndicated column *Matter of Fact* in the New York Herald Tribune on August 1, 1952 state that latest estimates indicate that the U.S.S.R. will have a minimum stockpile of 130 medium-power atomic bombs by the end of 1952 and more than 420 such bombs by the end of 1956.

Qualified experts have estimated that 450 to 660 medium atomic bombs delivered on targets would be enough to destroy this country's military potential. Certainly, a fraction of this number, say 100 bombs, would be enough to strike a severely paralyzing blow.

The above estimates are of course no more than informed guesses but they help to suggest the dimensions of the problem we face.

This then is the Soviet's probable military power without considering the hydrogen bomb, which the U.S.S.R. is reported to be ready to test in 1953.

No wonder both presidential candidates in the 1952 campaign sincerely and humbly tried to avoid the nominations of their respective parties!

The cost of maintaining a military force-in-being as large as Russia's is overwhelming and it is unlikely that it can be supported indefinitely by any national industrial economy, not even an economy organized along totalitarian lines. The necessary expenditures can be justified strategically only when a large-scale war is contemplated before the material with which the army is currently equipped becomes obsolescent.

Just when may the Kremlin set this massive striking force in motion? No one knows. Probably, not even the Politburo has a definite timetable but is waiting for the critical moment when it has such a clear superiority over possible opponents as to justify the military risk.

Our basic strategy must be to develop offensive and defensive power which will make attack seem unprofitable to the aggressor, or, if attack does come, to strike back with such overwhelming strength as to ensure ultimate victory.

A large modern army in the field depends on a steady flow of materiel from factories on the home front. There are three, and only three industrial areas in the modern world capable of supporting large-scale military operations. They are:

> Soviet Russia and her Satellite States
>
> Western Europe
>
> United States of America.

No one of these areas is superior in military and industrial strength to the other two combined. Any two, if fully mobilized, are superior to the remaining one.

At the present time, the defensive power of Western Europe and the United States are tied together under the North Atlantic Treaty Organization. NATO's Army is steadily being built up, and was scheduled to have 25 standing divisions by the end of 1952.

It is unlikely, however, that the NATO Army could by itself defeat Soviet military power, even when built up to full strength. What it may be able to do is hold up military advance in Europe long enough to bring into the picture the tremendous industrial potential of the United States.

American industrial production, then, occupies a vital place in global strategy and, in the last analysis, can be the deciding factor for war or peace, for the final victory of communism or of democratic freedom.

Conversely, Soviet strategists must consider how to counteract the limiting effect of American industrial production on their expansionist plans. Four basic countermeasures are available to them:

1. by increasing war production behind the Iron Curtain; this she is doing at a rapid rate, particularly in basic industries such as steel;
2. by forcing the Western Democracies to divert war materiel to other fronts, such as Korea and Indo-China;
3. by building up specialized naval forces, such as submarines, to interdict the transportation of material from the United States to Europe in case of actual conflict;
4. by direct military attacks on American production facilities.

In this *Report to Industry* we are concerned with the last of these four possibilities: direct military attack on factories in the United States.

If Soviet Russia could paralyze American industrial production long enough to let loose its full striking power against Western Europe, it might capture the industrial and military power now allied with us and thereby gain clear strategic superiority.

In fact, with the industrial production of Western Europe added to what she now has behind the Iron Curtain, she would eventually be able to arm many hundreds of additional divisions from the vast Asiatic and European populations under Communist control. With such military power at her command, it is conceivable that in the course of years, she would be in a position to launch a massive invasion of Continental United States.

We do not know how, or when, or where the struggle will commence, or even whether it will ever come at all. But we do know that a key element in the strategy of the aggressors may be all-out attack directly on American centers of production.

Part of the responsibility for defense of industry against such an attack rests on our own military forces. But a large measure of responsibility also rests directly on American business management.

In this Report we are specifically concerned with those measures which the business executive can and should take on his own initiative to mitigate the effects of such military attack on our physical plant.

Weapons of Attack

The weapons which conceivably might be used in military attacks on industrial centers in Continental United States include the following:

ATOMIC BOMB
ESPIONAGE AND SABOTAGE
OTHER WEAPONS
- Improved Atomic Bombs
- The Hydrogen Bomb
- Radiological Warfare
- Chemical Agents
- Biological Warfare
- Conventional Incendiary and High Explosive Bombs
- Ground Attack

The possibilities of each of these weapons has been discussed extensively and dramatically in the public press. It is important, however, for the business executive to have a clear-cut and realistic understanding of the relative importance of these weapons as a foundation for planning industrial defense.

In a word, this is the lineup at the present time:

atomic bombing—overwhelmingly important

espionage and sabotage—important, but industry's role is secondary to that of government agencies.

other weapons—not important enough to warrant any attention until plans for defense against atomic attack are well advanced.

Now, let us make a closer inspection of these messengers of death and destruction.

Atomic Bombing

So much sensational writing has been published on the atomic bomb and its effects that we are inclined to believe it is a weapon fantastically different from any earlier instrument of war, and therefore that we must discard all our previous concepts of defense and embark on a whole new approach.

Actually, the atomic bomb produces effects very

much the same as high explosives and incendiary bombs of World War II. The essential dynamics of both types of bombs is the same. They both release tremendous amounts of energy in a confined space in a very short time.

They differ in two important respects: (1) the Uranium-235 or Plutonium used in the A-bomb releases 20 million times as much energy, pound for pound, as the TNT used in conventional high explosion bombs, and (2) the atomic bomb also releases nuclear radiation which is destructive to human life.

The atomic bomb is mainly a saturation weapon; it concentrates in the space of seconds a magnitude of destruction which could be produced by conventional weapons only through continual attacks spread over hours or days. Atomic bombing swamps all normal defense preparations in the area under attack and does not give the defense forces a chance to recover and reorganize. Modern civil defense strategy, with its emphasis on immediate mutual aid from outside the stricken area is the key to industrial and municipal survival.

Nominal Atomic Bomb. Civilian defense planning is generally based on the calculated effects of a *nominal atomic bomb* which has an energy equivalent of 20,000 tons of TNT and is of the same size as the A-bomb exploded over Nagasaki and Hiroshima. This is the only bomb for which we have factual data regarding the destructive effects of an atomic explosion over a city.

In comparison, the largest World War II blockbuster contained an energy equivalent of ten tons of TNT, but two thousand 10-ton blockbusters would do far more damage than one A-bomb. The A-bomb literally packs too much punch in too small an area. It pulverizes the center of the area but does not cause as much devastation as 2,000 blockbusters exploded at widely separated points in an old type raid.

The atomic bomb is not an absolute weapon. It is finite. It produces definite effects, has measurable characteristics, and its limitations are known.

As a matter of fact, in the armory of modern war other weapons are, or, could become superior to the A-bomb under certain circumstances. But, as of today the A-bomb is the supreme weapon for long range strategic attack on American industrial centers, and for a very simple reason which is familiar to military strategists and business executives alike, namely, it produces greater net destructive effect on the target in comparison with net cost of production and delivery than any competing weapon.

Experience in World War II demonstrated that the greatest military advantage to be gained from aerial bombardment is through destroying the worker's ability to continue working. This was accomplished by direct destruction of his body or of the community and public services on which he depended in his daily living. The unpleasant truth is that it is easier to destroy the worker who mans an industrial machine than to destroy the industrial machine at which he works. Most machinery can be replaced in a matter of weeks or months. But in a country which is using its war-power population to the maximum, it takes twenty years to replace a worker.

For this reason, densely populated cities containing a number of industrial targets are more rewarding than scattered military objectives or outlying industrial plants. This is demonstrated by the exceptional effectiveness of our aerial bombardment of both Japan and Germany before the A-bombs were used. The number of Japanese civilian casualties in the homeland inflicted entirely by our Air Force during a six-month period was nearly twice the Japanese military casualties caused by our combined army, navy, air force and marines during the forty-five months of fighting in the Pacific.

We must recognize therefore that large-scale destruction of the industrial population has been established as an integral part of the strategy of modern war. The A-bomb has simply served to facilitate and implement this strategy. The A-bombs over Hiroshima and Nagasaki did about the same damage as large-scale raids with conventional incendiary and high-explosive bombs would have. This can be illustrated by comparing raids on Hamburg and Tokyo, which were bombed with conventional incendiary and high-explosive bombs, with the A-bomb attacks on Hiroshima and Nagasaki, as set forth on Table A.

It will be noted from the above table that damage in terms of casualties from atomic bombs is about the same as from conventional bombs. Wherein then lies the great advantage in the atomic bomb? The simple fact is that the atomic bomb is a more economical weapon for the mass destruction of the civilian population than traditional forms of aerial bombardment. It will be noted for instance that 279 planes were required for the raids on Tokyo whereas only 1 plane was required for the raid on Hiroshima.

There are other factors which make the atomic bomb a more valuable weapon in terms of its general effect, in spite of its extremely high unit cost:

First, use of the atomic bomb as the opening move in a major war capitalizes on its surprise value. It is quite probable that it can be delivered on targets in the United States with no warning at all, or with at most a few hours alert.

Secondly, use of the atomic bomb does not directly

commit other military forces to combat. Ground armies can be held mobilized close to the homeland awaiting counter-moves.

Thirdly, the atomic bomb is highly flexible in the sense that a single bomb can be used, or a very widespread attack can be mounted.

Fourthly, the atomic bomb is the only weapon which can penetrate our Continental defenses at the present time in sufficient quantity to produce strategic results.

Fifthly, it strikes directly with the first blow at the production centers of war material on which the defending military forces must depend in developing and executing a full scale counter attack.

Sixthly, the atomic bomb completely destroys buildings and equipment, over such a wide area as to produce a paralyzing effect which greatly nullifies civil defense counter moves.

Seventhly, the atomic bomb kills and injures so many human beings that there is wide spread disruption of community relationships and industrial production which could make it impossible to resume manufacture of war material even if structures were left intact.

Espionage and Sabotage

The planning of a military campaign begins with the gathering together of all possible information regarding the capacities and intentions of the enemy. Accurate information may mean military success while lack of information may lead to false estimates of the situation and failure. The securing and correlating of all such information is the responsibility of the military intelligence service. One method of obtaining military information is through espionage.

All nations use spies for military purposes. The Soviet Union however has an extraordinarily large and well developed spy system based in part on the international Communist party. It is a particularly difficult espionage system to counteract in this country because so many of its agents are native born American citizens leading apparently normal harmless lives.

This weapon is in use all the time and must be dealt with continuously.

Closely allied to espionage in methods is *industrial sabotage* which is a basic activity of the Communist party and other revolutionary groups. While no damage in the last war was directly traceable to enemy sabotage, it cannot be hoped that we shall be similarly spared in a war in which our domestic Communists are involved.

While these two weapons offer a serious threat to our security, they are definitely secondary to the atomic bomb in so far as industrial management is concerned because (1) even a very large, cleverly planned, and well executed, sabotage program could not do as much damage as an atomic bomb attack, and (2) primary responsibility for counter measures rests with the Federal Bureau of Investigation and other Federal agencies.

At the same time management has a definite role to play in support of these agencies, a role which is described in more detail in Chapter XII.

Other Weapons

While the other weapons which theoretically could be used in military attacks on American industrial plants are not of primary importance at the present time, they have been discussed so widely it would be

TABLE A
Casualties from Aerial Bombardment in Four Cities

CITY	HAMBURG	TOKYO	HIROSHIMA	NAGASAKI
Date	July 24 to August 3, 1943 (3 raids)	Night of March 9-10, 1945	August 6, 1945	August 9, 1945
Killed and Missing	60,000 to 100,000	83,000 to 110,000	70,000 to 180,000	36,000 to 73,000
Injured	37,000	102,000	70,000	40,000
Bomb Load	7200 tons	1667 tons	1 A-bomb	1 A-bomb
Number of Planes	2100	279	1	1
Square Miles Destroyed	12.5	16	5	2

U. S. AIR FORCE PHOTOGRAPH

Desolated Hiroshima after main thoroughfares had been cleared of debris

well to set them in perspective so that the ground can be cleared for work on the more pressing problems and to give recognition to the fact that one or more of the "other weapons" could become of paramount importance in the future.

Improved Atomic Bombs. Actually, bombs of several times the energy equivalent of the nominal atomic bomb used over Hiroshima and Nagasaki have been developed and tested, and still more powerful bombs are in sight.

As a matter of fact, the 1952 test program of atomic weapons at the ENIWETOK proving ground in the Pacific is scheduled to culminate in the explosion of a "super-bomb" expected to yield an energy release equivalent to 300,000 to 500,000 tons of TNT.

As pointed out earlier a larger bomb would be less efficient than the present size; more of the power would be wasted at the center of the explosion, hence there is more danger in the development of a somewhat smaller size A-bomb than from the development of a super bomb.

Increasing the power of an explosion does not increase, in proportion, the total area affected. A bomb twice as powerful as a nominal atomic bomb, for example, will cause severe damage in an area only 60% greater than the area severely damaged by a nominal bomb. An atomic bomb ten times as powerful will cause severe damage within a radius from the explosion center only a little more than twice as great as the one mile radius of the nominal bomb.

The defense measures which can be carried out in the first few months of preparation would be virtually the same for any size bomb. By the time any plant has completed its initial defense plan, information may have been published on the larger bombs now in existence. Even this, however, will not require much change in planning for most plants. In any event, it must be recognized that as new and more powerful weapons are developed over the years ahead, changes must continue to be made in defense planning.

The Hydrogen Bomb. Within the past two years both the United States and Soviet Russia have successfully completed tests indicating the possibility of the hydrogen bomb. Both countries are expected to explode test models in the near future.

There is no theoretical limit to the size of a hydrogen bomb. Its explosive force will be measured in *millions* of tons of TNT rather than *thousands* of tons as for the present type atomic bomb.

The limiting factor will probably be the size of the plane available to carry it to target and an economic determination of the optimum size based on a ratio between cost delivered on target versus amount of damage expected at point of delivery.

The effects of a hydrogen bomb on an industrial-population target would be the same as for an atomic bomb but on a much larger scale. Likewise the defensive preparations would be the same in nature but much larger in scale.

Radiological Warfare. This can be defined as the use of radioactive materials other than by atomic bomb explosion to render an area or objects unusable by a military opponent. While this is technically possible, it is not considered a very likely use because (1) it is not easy to produce large amounts of radioactive materials; (2) they cannot be stockpiled for long periods since they decay continuously; (3) it is difficult to lay down enough material to cause serious injury; (4) they would render the area unusable by the aggressor. The possible use of this weapon need not enter into industrial defense planning at the present time.

Chemical Warfare. In World War I, gases of terrible effectiveness were developed and used, definitely establishing their military value. In World War II, Germany prepared for field use still more terrible chemical agents—the so-called "nerve gasses": tabur, soman, and sarin. They are odorless and invisible, and act very rapidly, affecting both breathing and circulation. They can cause death in anywhere from a few seconds to an hour, depending on how concentrated a dose the victim receives. The conventional gas mask is all but useless against these lethal agents.

There is no question but that chemical warfare could cause widespread death and injury if the deadly gases could be delivered in sufficient quantities to American cities. In some ways chemical attack could be worse than atomic bombing. Nevertheless there are a number of reasons why industrial management should not invest any time, money, or energy at the present time in preparing defenses against this form of attack.

First of all, the airline distances from Russian-held bases to targets in the United States are so great that each plane must carry a heavy loading of aviation fuel thus greatly reducing the load of weapons per plane. Such a vastly greater tonnage of chemical agents would have to be carried to produce the destruction equivalent of atomic bombs as to eliminate them from consideration for long range attack.

Secondly, technical problems in distributing gases from airplanes, particularly with respect to weather conditions, presents an added disadvantage not found in the atomic bomb.

Thirdly, fear of retaliation is an effective inhibitant against use of this weapon. During World War II Germany had stockpiled at least 125,000 tons of its new nerve gases but did not use them for fear that the

allied air forces would immediately have laid heavy gas attacks on German cities.

Our forces in the field kept large quantities of mustard gas available for instant use. We never resorted to the use of gas attacks because we had renounced this particular form of warfare as an aggressive weapon and we did not need to use gas defensively because we had clear superiority in the air, and air power is the key to successful gas warfare. If the air war picture had been different, Germany would certainly have used her gases against our troops and possibly against British cities.

The Chemical Warfare Service of the United States Army has continued the development of new and improved gases, and, as a result, the United States is now in a position to retaliate immediately with chemical agents that are not less deadly than any which an enemy might possess. There is every reason to believe that the same fear of retaliation that prevented Germany from using gas, even when suffering defeat, will be equally effective in preventing its use against us by a new enemy—that is, as long as we have strategic superiority in the air.

Fourthly, the problem of developing adequate defenses against chemical warfare is very great indeed, requiring tremendous quantities of gas masks, decontaminating equipment, decontaminating materials and a very extensive public training program. Such equipment and materials are not now available, and will not become available until the Federal government determines that the degree of risk justifies the investment.

Fifthly, the development of adequate defenses against atomic attack will require more time, money and energy than could possibly be made available. Good strategy and just plain common sense calls for concentration of all resources on protection against the very real and present danger of atomic attack without diversion of resources to defense against less probable weapons.

Biological Warfare. Biological warfare has been waged against humanity by nature from time immemorial in the form of the innumerable diseases which occupy the attention of medical science. The human organism throws off most of these natural enemies without any outside help. If, however, such an attack gets out of hand and results in disease, the family doctor can usually provide the answer for the individual.

Where such natural attacks become widespread and result in epidemics, public health measures can successfully combat them. Although disease can spread quickly, most outbreaks move slowly. It is probable that our present extensive public health measures would quickly detect use of biological agents and introduce proper measures to counteract their effect.

Forget about new "mystery" germs and poisons. During the past few years a great deal of foolish talk has been heard about supposedly new types of germs and poisons so powerful that even a thimbleful could kill millions and millions of people. Most of this is pure scare talk built on twisted facts.

If such biological military agents were to be used, the countermeasures would depend upon the identification of the specific agent. Then the public authorities could advise the public on the measures to be followed. These measures would represent for the most part an intensification of standard public and industrial health precautions to which we are accustomed in peacetime.

Conventional Bombs. Conventional high explosive and incendiary bombs still have a very real place in modern warfare; however, their use is likely to be confined to tactical purposes in support of ground military operations. It is improbable that they will be used against American industrial installations unless we are actually invaded.

The A-bomb has absolute superiority over conventional bombs for long range strategical area bombing because of the limited bomb load capacity of planes attacking the United States from air bases in Russian territory, as discussed in connection with the possibility of chemical warfare. In any event the blast and fire effect of conventional bombs is substantially the same as of the atomic bomb. Accordingly, defense preparations for the atomic bomb would be equally effective against conventional bombs.

Ground Attack. Ultimately invasion of continental United States from Europe or Asia will no doubt become practicable; but it is out of the question at the present time, and for many years to come.

The logistical problems involved in such an operation are enormous, and the Russians are notoriously weak in this branch of military planning. Furthermore it would require many years to develop and organize the naval forces and maritime services necessary to transport and protect the vast numbers of troops and amount of material which would be required.

The Main Issue

Beyond peradventure of a doubt the threat of atomic attack on American industrial centers is of such overwhelming importance in comparison with the threat of other weapons as to leave no doubt what the main issue must be in planning industrial defenses.

The American industrialist must face the possibility of atomic attack without warning at any moment of the day or night for many years to come, with the consequent destruction of his business, his community, his nation, and his way of life—this is the *ever-present danger.*

And for this ever-present danger there must be an ever-ready defense.

CHAPTER II

NATURE OF THE ATOMIC BOMB

A NUCLEAR EXPLOSION is the phenomenon resulting from bringing together with extreme rapidity a sufficient mass of Uranium-235 or Plutonium to initiate a chain reaction in which the atoms split apart releasing a great amount of energy within a confined space and a very short period of time.

This process may be easier to understand if we take a look at a few of the high points in the development of atomic energy.

Back in 1905, when Albert Einstein advanced his famous *theory of relativity,* he suggested that matter is convertible into energy, and energy into matter under certain conditions; in fact, matter is energy in a different form: frozen energy. Furthermore the amount of energy in matter is in exact ratio to its mass, and this ratio can be described mathematically by the equation, $E = MC^2$, in which E is energy, M is mass, and C is the velocity of light.

If this is stated in actual numbers, its startling character is apparent. If 2.2 pounds (one kilogram) of coal is burned it may release 8.5 kilowatt hours of energy. Actually only a very tiny portion of the mass would be converted into energy, the balance would remain in the form of ash, evaporated moisture, etc. However if the entire mass of 2.2 pounds of coal is converted into energy according to the formula $E = MC^2$, 25 billion kilowatts of energy would be released, which is equal to the energy produced in a full month of operation by the entire electric power industry in the United States.

Scientific research demonstrated that such a change of mass into energy with consequent decrease in the weight of the original mass does take place spontaneously in nature; for instance, radium gives off energy, loses weight, and eventually breaks down into lead which is stable, that is, not spontaneously radioactive.

Obviously if the direct conversion of mass into energy could be started, maintained, and controlled, by man, physical power would be available for civilized uses on a scale hitherto undreamed of.

The feasibility of such a process was demonstrated on a very limited laboratory scale in 1919 through artificial disintegration of nitrogen into atoms of oxygen with consequent release of energy. Experimentation continued and more and more was learned about the atom with the aid of the cyclotron and other laboratory devices and techniques. This was of great scientific interest but still of no practical value because it took more physical energy to produce this result than was given off in the end product. What was desired was a process which once started, would be self-sustaining and would continue to give off energy over a period of time, as takes place in the ordinary combustion of coal in a furnace.

In January, 1939, at Columbia University, the Uranium atom was split, giving off energy, but the process was not self-sustaining.

A bit of clever scientific detective work followed. Uranium metal as it occurs in nature is composed of three kinds, or isotopes, each of which is slightly different atomically. The three types are:

U-238 — 99.282%
U-235 — 0.712%
U-234 — 0.006%

Each of the three isotopes was isolated and tested for radioactivity, which soon revealed that U-235 was the vital substance and that a chain reaction could be started with U-235 which would give off more energy than was required to start the process.

Thus by June 1940 the scientific world had demonstrated the practicality of converting mass into energy by nuclear fission on a self-sustaining basis.

The basic physics of this reaction can be explained in a roughly simplified fashion as follows.

An atom of U-235 is composed of a nucleus surrounded by 92 electrons. The nucleus itself contains 92 protons and 143 neutrons, a total of 235.

These protons are all electrically positive and therefore ought to repel one another with enormous force. Somehow these electrical forces are held in check by an unknown binding energy: nuclear energy.

As long as the parts remain in balance, the nucleus is stable, but if this balance can be upset by adding an extra proton or neutron, the nucleus breaks up, releasing some of the binding energy which held it together.

With the release of energy comes a decrease in mass. The remaining electrons, protons and neutrons rearrange themselves into patterns of more stable elementary substances.

This splitting of the atom is called *fission.* When an atom of Uranium-235 breaks apart, it not only releases some of its own binding energy, but it sets free one to three neutrons which enter other nearby atoms and upsets *their* nuclear balance. This second stage in turn causes the release of additional binding energy and the release of additional neutrons. The process continues to a third stage with release of still more binding energy, and additional free-flying neutrons. At each stage there will be twice as many new fissions caused: 1, 2, 4, 16, 32, 64, etc. The result is an uncontrolled expanding *chain* reaction, all of which takes place in less than a millionth of a second—with release of a tremendous amount of binding energy in the form of a nuclear explosion.

The active material in an atomic bomb, Plutonium or Uranium 235, is a dense, white, brittle metal, similar to Chromium but twice as heavy as Lead. Within an orange-sized sphere of this metal is captured and compressed a potential of pure electrical energy sufficient to flash forth as a lightning bolt a mile wide and ten miles long.

Pound for pound U-235 is about 20,000,000 times as powerful as TNT, the best previously known military explosive. The fissioning of 2.2 pounds will release the energy equivalent of 20,000 tons of TNT.

The fission process starts spontaneously whenever a sufficient quantity of U-235 is brought together in one mass. The exact quantity necessary to cause an explosion is known as the *critical size.* Less than this amount will produce no results. The amount of U-235 necessary to produce a spontaneous explosion has been estimated to be from four pounds to more than a hundred pounds.

To use atomic energy effectively in a weapon it was necessary to procure sufficient quantities of the rare fissionable materials and to design and construct a bomb mechanism which would bring two or more subcritical masses together in such a manner as to result in a large explosion over an enemy target.

The application of wholly new scientific information to industrial and military uses usually requires many years of applied research and development, with the work moving from one phase to the next in logical sequence.

The great question was: could the vast technical, industrial, and managerial problems presented in this case be solved in time to be of use in World War II.

As early as March 1939, only a few weeks after the discovery of Uranium fission, the possible military importance of atomic energy was called to the attention of the government. In June 1940 responsibility for further exploration was assigned to the National Defense Research Committee, which reported in December 1941 that the calculated probability of obtaining atomic bombs was great enough to justify an "all out" effort for their development.

Responsibility for carrying the program through the next phase, namely application of scientific knowledge to the specific development of an atomic bomb, was assigned to the Office of Scientific Research and Development, and in June 1942, OSRD submitted a report stating that a workable bomb could be designed and built and necessary fissionable materials obtained to provide a decisive weapon soon enough to be of military significance.

In August 1942, the Manhattan Engineering District was established in the War Department to carry the program through the final stages. The whole program was brought to a successful climax from a military point of view with the explosion over Hiroshima on August 6, 1945.

And mankind faced a new threat to its civilized institutions.

Physical Effects

The tremendous energy released by the bomb is in two forms:

heat (thermal radiation)

radioactivity (nuclear radiation).

Such a large amount of heat energy is released explosively in the bomb that there is a very sudden rise in temperature. This intense heat causes the bomb container and the fission products to change almost instantly and completely into gases or vapors. These hot gases are at a very high pressure in a restricted space, and accordingly start to expand outward in all directions, pushing away the surrounding atmosphere with such sudden force as to produce the blast effect which is characteristic of all explosions.

So then we have the following principal physical effects from an exploding atomic bomb:

Blast—about 144 trillion pounds per square foot at the center of the bomb

Heat—over 40 million degree centigrade

Radioactivity—equal to a million tons of radium

As this tremendous quantity of energy moves away from the center of the explosion in its various forms it affects objects in its path destructively, the intensity

of such destructive effect diminishing with increasing distance from the center of the explosion.

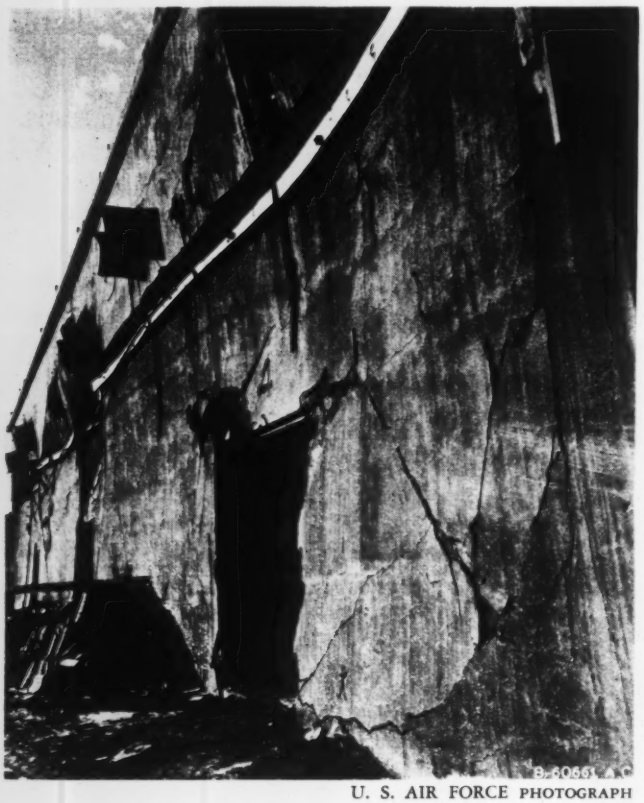
Each of the three principal physical effects—blast, heat and nuclear radiation—produces its own kind of damage. We shall describe each of these separately, basing our information on the handbook, *The Effects of Atomic Weapons,* prepared by the Atomic Energy Commission. [2-4]

In keeping with the general practice of civil defense planning our discussion will be in terms of a nominal atomic bomb exploding 2,000 feet in the air, which is the approximate height of the Japanese explosions and the level which is calculated to produce the maximum damaging effect in urban areas.

Blast Effect

The blast and shock wave moves away from the center of the explosion with the speed of sound, hits physical objects and tends to knock them out of its path like the fist of a prizefighter colliding with a jaw.

The danger is due not only to the A-bomb's tremendous force but to the *length of time* the force lasts. As the shock wave moves out from the bomb burst, pressure develops in front and suction in back, both being accompanied by high wind. The pressure builds up instantly to its maximum force—the colossal *punch* effect—followed by a steady but rapidly diminishing *push.*



U. S. AIR FORCE PHOTOGRAPH

Impact of shock wave from atomic explosion on concrete wall of Prefectural Agricultural Association in Hiroshima

This interplay of forces is devastating. Pressure at one-half mile from the blast center is 2,200 lbs. per square foot. Against these figures the average office building floor is designed to support only 75 to 100 lbs. per square foot, the average warehouse 150 to 200 lbs.

A brief review of Japanese experience at varying distances from ground zero is given in Table B. "Ground zero" is the point at the earth's surface directly below the airburst of an atomic bomb.

Heat Effect

The heat energy released by the bomb travels in straight lines like light and is called *thermal radiation.*

The original terrific temperature inside the ball of fire produced by the atomic explosion falls off rapidly. One one-thousandth of a second after the explosion, the temperature is down to 300,000 degrees centigrade. One full second after explosion, the temperature is 5,500 degrees centigrade.

Directly beneath the bomb at ground zero the temperature is 7,000 degrees centigrade at first, falling off in a few seconds to 3,500 degrees centigrade.

Thermal radiation can kill, burn and sear over an area roughly equal to that seriously damaged by the blast. Although the temperature of thermal radiation is of exceptional intensity, it lasts such a short time that it does not have a chance to penetrate into objects. Frequently the effect of this very intense but brief heat is to char or burn the surface of an object without actually causing it to break into flames.

Because of its short duration, thermal radiation is also referred to as "flash heat" and the effect it produces on objects is called "flash burn," to distinguish it from ordinary fires which break into actual flames, causing "flame burns."

Since this flash heat passes so quickly, a small amount of shielding protects an object completely. Even differences in thickness or color of clothing of persons in Hiroshima and Nagasaki made a difference in transmitting heat to the body. This was reflected in a pattern of burn on the skin which revealed a light burn effect where the clothing was heavier, as at the seams, in contrast to heavier burn effects where the clothing was thinner. The same sort of burn pattern resulted from differences in color of clothing: heavy burn under light-colored parts of the garment, milder burns under darker areas.

Since the heat rays travel in straight lines from the exploding bomb they affect primarily that side of the object which faces the burst. This effect is so marked that one side of an object will show severe burns while the farther side will be untouched.

TABLE B

Physical effects of blast and heat radiation of nominal atomic bomb exploding 2,000 feet in air at progressive distances from ground zero.

Distance from GZ in miles	Area of damage in square miles	Wind velocity in MPH	Air pressure pounds per sq. ft.	BLAST EFFECT	FIRE EFFECT	
					Material	Effect
				Area of Complete Destruction VIRTUALLY COMPLETE DESTRUCTION OF ALL BUILDINGS		
0.5	.75	440	2,200	18-inch brick walls completely destroyed	roof tiles black maplewood unprotected humans	melted by heat burns fatal burns
				Area of Severe Damage MAJOR STRUCTURAL DAMAGE THAT WOULD RESULT IN COLLAPSE OR LIABILITY TO COLLAPSE OF BUILDINGS		
1	4	185	1,100	12-inch brick walls severely cracked Multi-story brick buildings destroyed Light concrete buildings collapsed Steel frame buildings destroyed—mass distortion of frames	synthetic rubber Philippine mahogany white paper dark blue serge green gabardine gray cotton shirting unprotected humans	burns burns burns loose fibre burned burns burns second or third degree burns
				Area of Moderate Damage SHORT OF MAJOR STRUCTURAL DAMAGE, BUT SUFFICIENT TO RENDER STRUCTURES UNUSABLE UNTIL REPAIRED		
1.5	8	110	500	8-inch brick walls cracked Structural damage to multi-story brick building Heavy damage to window frames, doors and panels Electric installations and trolley cars destroyed Severe damage to homes	douglas fir foliage black paper unprotected humans	burns scorched burns severe burns
				Area of Partial Damage BUILDING USABLE BUT REQUIRING SUBSTANTIAL REPAIR IN EXCESS OF PLASTER AND WINDOW REPLACEMENTS		
2	12	65	280	Blast damage to majority of homes Partial damage to nonresidential structures Heavy plaster damage	dry combustible materials unprotected humans	flash ignition moderate burns
2.5	20		220	Windows and doors shattered Moderate plaster damage Light damage to window frames Complete destruction of windows	telegraph poles unprotected humans	flash charring slight burns
				Area of Light Damage MOSTLY PLASTER DAMAGE AND WINDOW BREAKAGE		
3	28		20	Light damage to windows, frames and doors Many windows broken		
8	200			**Approximate Limit of Light Damage**		

Table B shows the fire effect of thermal radiation progressive with distance for certain substances, based on Japanese experience.

Curiously enough, thermal radiation is not likely to start serious fires. When the objects lie close enough to the explosion to be ignited by thermal radiation, the follow-up blast winds usually blow out the flame. For this reason it would appear that relatively few of the many fires which sprang up within a radius of some 5,000 feet from ground zero in the A-bombing of Japan were due directly to thermal radiation.

More probably the fires originated from secondary causes such as the upsetting of charcoal or wood stoves, electrical short-circuits, the breaking of gas lines and so on—all of these being caused by the blast wave. In several cases fires were started in industrial plants by the overturning of furnaces and the collapsing of buildings on top of them.

Nuclear Radiation

The third major physical effect of an atomic explosion is the release of a great amount of energy in the form of nuclear radiation.

Nuclear radiation, like thermal radiation, shoots out in straight lines from the center of the explosion, diminishing in intensity as it moves outward.

The danger from the initial flash of radiation is over in a few seconds. About half of the radiation that reaches the earth, following an air burst, arrives in the first second, and about half the remainder arrives in the next five seconds. The damaging effect entirely disappears in less than a minute.

Japanese rescuers and damage control officials reported that they could go anywhere in the damaged area at no personal risk within a few minutes after the explosion.

This experience of the Japanese was fully confirmed by the U. S. Atomic Energy Commission in a published statement based on the Eniwetok tests held in the spring of 1951. The A.E.C. statement reads in part:

> Our experience in recent test programs repeatedly has demonstrated that radiation hazards will not delay rescue and recovery work after an air burst of an atomic bomb.
> Rescue, fire fighting and recovery work can begin immediately in any area where there is life, as in any major catastrophe caused by conventional air attacks, earthquakes, or disasters on the scale of Texas City. . . .

Four varieties of radiation are released by the exploding atomic bomb. (1) Alpha particles; (2) Beta particles; (3) Neutrons, and (4) Gamma rays.

The Gamma ray is the only true ray of the four in the sense that sunlight is a ray. It cannot be seen or felt and even a lot of it could not be "weighed."

The other three are solid physical things. An exceptionally powerful microscope would make them visible, and a sufficient amount could be weighed. However, they do shoot out in straight lines from the explosion and in this sense are classified as types of radiation.

Alpha and Beta particles present no civil defense problem since they can travel only a few feet in the air and cannot penetrate much solid material. A few sheets of paper will stop Alpha particles and ordinary heavy clothing will halt Beta particles.

The *Neutron* is so small and moves so fast that it is very penetrating and considerable amounts of dense shielding would be required for protection close to the explosion. The neutron has another important characteristic. When it hits certain substances—salt, iodine, gold, for example—it causes the substance to become dangerously radioactive. The neutron is the only one of the four forms of radiation produced by the atomic bomb which will have this effect. However, it is unlikely that the neutron would cause serious damage in moderately high level air burst, say 2,000 feet, since the lethal range of neutrons from a nominal atomic bomb is only about 1,800 feet.

Gamma Rays. An explosion of a nominal atomic bomb, in a high air burst, may result in many casualties from gamma rays. The quantity of gamma rays released by such an explosion is almost unbelievable and they are very penetrating. Neither ordinary clothing, nor any conceivable clothing can check them. It would take 30 inches of concrete to reduce the quantity below the fatal amount at 2,000 feet, and over 22 inches at 3,000 feet. Beyond about 6,000 feet, little if any protection is necessary, and at 7,000 feet gamma rays become harmless.

The gamma ray flash accompanies the heat flash, but is invisible. The damaging effect on the human organism is not felt at first by the victim, and symptoms do not appear for 24 hours or more.

It is important to know just what constitutes an injurious or lethal dose of radiation. Radiation has definite units of measurement, just as *pounds per square foot* was used to measure blast pressure, and *temperature in degrees centigrade* was used to measure the intensity of heat from the bomb. The unit for measuring the amount of radiation entering the human body, or *dosage*, is called the *Roentgen (R).*

The period of time during which radiation is received is also important. A given amount of dosage, i.e. Roentgens, which would be fatal if received in a few seconds, could be completely non-injurious if received in small amounts over a much longer period of time.

TABLE C

Amount of Gamma ray dosage and probable damage received by humans directly exposed to the air burst without protection or shielding of any kind at progressive distances from air burst of nominal atomic bomb.

Distance from explosion in feet	Gamma ray dosage in Roentgens	Killed %	Degree of damage to survivors
2,000	10,000	100	No survivors
3,000	2,500	100	No survivors
4,000	600	95	Disability certain
4,200	400	50	Disability certain
4,800	200	15	Disability possible; injury probable
5,200	100	5	Some injury possible; no disability
5,700	50	0	Some symptoms; no serious injury
6,300	25	0	No injury

Not all human beings react in the same way to the same dosage of radioactivity. Some people have more resistance than others. This variation can be expressed in terms of mathematical probabilities: 90% of those receiving a dosage of 600 R within the space of a few minutes will die, but only 50% receiving a dosage of 400 R; 5% of those exposed will have so little resistance that they will die from a dosage of only 100 R. The actual percentage of deaths will be decreased further if proper medical treatment is received promptly after exposure.

This relationship between distance from explosion, intensity of gamma ray dosage, probable percentage killed, and degree of damage to survivors is shown in Table C.

Radioactive Cloud. As mentioned earlier, some of the fissionable material of the bomb—Uranium-235 or Plutonium—changes directly into energy in the form of heat or nuclear radiation, while the balance breaks down into other elementary substances in a process which goes on for some time accompanied by continuous release of nuclear radiation. The fission products producing this continuing radiation are carried outward and upward from the exploding bomb in a white hot, rapidly expanding cloud. Most of the radioactivity in the cloud is short-lived and dies away in the course of a day or so; however, a significant proportion of this radioactivity is long-lived and would be dangerous if it fell out of the cloud and reached the inhabited surface of the earth in appreciable amounts.

Shielding

Necessarily the effects of blast, heat and radiation have been stated above in general terms. However, there are many factors of a technical nature which tend to vary the actual effect. One of these is *shielding*, which has a very marked effect on the damage the explosion may do to human beings. For instance, individuals in shelters very close to ground zero survived without any ill-effects from radiation, blast or heat. This is of exceptional importance in planning industrial defense. The technical factors on which the exact amount of shielding is based are complicated and need not be discussed here. However, some practical measures which can be taken to capitalize on protection possibilities in industrial structures are referred to in Chapter X.

Delivering and Exploding the Bomb

Under existing circumstances, the most feasible way for the Soviets to deliver the atomic bomb on industrial centers is by long range bomber. Russia has virtually no surface navy to compare with American naval strength, although she is accelerating construction of naval craft. Guided missiles capable of doing the job are not in sight for years.

For technical and tactical reasons the possibility of a bomb being smuggled in and assembled in this country at a point where it could be effectively used is

rather remote. In any event, the difference in form of delivery has very little to do with the nature of defense plans.

The atomic bomb can be placed to explode in the air, at ground level, underground, or under water.

Ground level and underground explosions are possible but very unlikely because they are difficult to carry out and the total destructive effect is much less than for an airburst. Furthermore, an underground explosion would be difficult to carry off effectively.

An underwater burst is a bit more probable than ground level, or underground, but still not too likely. An underwater burst requires very precise aiming for maximum damage and, like the groundburst, its total destructiveness is not as great as with an airburst.

The overwhelming probability is that the bomb will be dropped so as to explode high in the air over the target, say at 2,000 feet altitude. This is the way to get maximum destructive effect. It is in this frame of probability that industry should carry on its precautionary planning. Furthermore, virtually all of the planning for defense against an airburst would apply just as well to underground, ground level or underwater explosions.

The major difference in the last three types is that while there would be increased danger of radiological contamination, there would be far less danger from fire. There would be no flash heat of any consequence, the area of devastation would be considerably less, and immediate radiation would be reduced to a negligible factor except in the area close to the explosion.

CHAPTER III

ATOMIC ATTACK ON A CITY

EXPLOSION OF AN atomic bomb over an industrial community causes death and destruction over a wide area with complete cessation of all normal activity including industrial production.

As mentioned in the previous chapter the A-bomb produces its destructive effect through the sudden release of tremendous physical energy in the forms of blast, heat and nuclear radiation. The center of destruction is directly beneath the explosion—ground zero. The damage effect diminishes with increasing distance from ground zero.

For an area of a square mile around ground zero in the average American city, virtually all structures would be completely destroyed. Assuming that some warning preceded the attack, 75% of the population would probably be killed, 15% suffer severe injury, and 10% might survive unscathed.

Surrounding this area of complete destruction would be a circular band of about 3 square miles in which most buildings would be so severely damaged that there would be little hope of repair and reuse. Of the population in the area at the time of the explosion, 30% would probably die, 20% sustain serious injury, and 50% remain unhurt. This area would be the scene of intense defense activity designed to put out fires, rescue trapped persons, save lives through first aid measures and transportation of the wounded to medical stations. These defense activities would be severely handicapped by lack of water, streets blocked by debris, threat of a rising conflagration, lack of power and light and other handicaps too numerous to mention.

In the third circular band out from the center of the explosion covering an area of about eight square miles, most structures would be so badly damaged that they would not be usable but probably could be repaired. Up to 5% of the population would be killed, 25% seriously injured, and 70% come through safely. Defense activities would also be proceeding intensely in this area but with less handicaps such as lack of water and electric power and debris-clogged streets.

The remaining periphery of direct physical damage would be about 200 miles in area. Most structures would suffer some damage but would probably be at least partially usable after the raid. Few persons would be killed or severely injured. The resources of this area, however, would be totally absorbed in mitigating the effects of the explosion in their own area and in the areas close to the explosion.

Even beyond this area of physical damage all community life will be disrupted by the effects of the explosion. The damage from the explosion of even one nominal atomic bomb is beyond the capacity of the resources of even our largest city to control. The resources of a whole region must be mobilized to mitigate the effects of the attack.

Once the immediate damaging effect of the explosion has been brought under control, there still remains the long and weary task of rebuilding the fabric of normal life. The effects of the explosion will last for years.

Essentially the effects of atomic explosion are much like those of a peacetime disaster—such as, for instance, the earthquake and fire at San Francisco in 1906, the Chicago fire of 1871, the Florida hurricane of 1928, and the Mississippi Valley floods in 1937.

These peacetime disasters, terrible as they were, with great loss of life and property, were much less in extent than damage from an atomic attack. Nevertheless, they were beyond the resources of the local communities and required help from the outside.

An atomic attack on a city may come simultaneously with similar disasters in many other cities . . . cities from which help might otherwise come in a peacetime disaster.

Since we do not have direct experience with effects of atomic explosion on an American city, it is necessary to deduce probable effects from other sources. Our principal sources of information are as follows:

1. Experience of German, Japanese and British cities which were subjected to atomic attacks, or the equivalent. The United States Strategic Bombing Survey carried out an extensive field research program on the effect of aerial bombardments, including the atomic attacks on Hiroshima and Nagasaki, and has assembled hundreds of volumes of data.
2. Publication of technical data based on scientific research, and test A-bomb explosions; the main publication in this field being the A.E.C. hand-

book referred to earlier, *The Effects of Atomic Weapons.* [2-4]

3. Experience with peacetime disasters. The leading agency in this field is the American National Red Cross.

The United States Strategic Bombing Survey has pointed out that no two cities, whether in Japan or the United States, are exactly alike. But the differences in terrain, layout and zoning, density and type of construction can be allowed for, one by one, and then some comparisons become possible.

Destroys Buildings

The explosion of a nominal atomic bomb in a high airburst causes damage to structures and their contents in the following ways:

the *blast* wave knocks down buildings,
the *falling debris* crushes or covers equipment, and other building contents (including human beings),
thermal radiation starts some fires,
secondary effects start thousands of small fires.

Nuclear radiation from a high airburst causes no damage to buildings and equipment.

Because of the widespread conflagrations which follow an atomic attack it is not possible to distinguish between the damaging effects of blast and fire. Most buildings crushed by the blast wave were further consumed in the following sea of fire.

The official Japanese figures summed up the building destruction in Hiroshima as 62,000 of a total of 90,000 in the urban area—69% destroyed.

In Nagasaki, blast and fire destroyed or seriously damaged 20,000 out of 52,000 buildings—38%.

In the opinion of engineers of the Strategic Bombing Survey, typical American buildings would react to the A-bomb in much the same way as their Japanese counterparts. The overwhelming bulk of the buildings in American cities could not stand up against an atomic bomb bursting a mile or a mile and a half away. Of 592,000 structures in New York, only 13,000 are considered blast-resistant. 572,000 are considered vulnerable!

Blast Damage

The trillions-of-pounds-per-square-feet pressure at the center of the nuclear explosion bursts forth in a colossal hurricane wave of destruction, shooting out in all directions, slamming buildings to the ground, tearing thousands of tons of masonry blocks loose from structures and sending them hurtling through the air as deadly missiles which topple, crush, and bury men, machines and small structures over a wide area.

There is one important difference between the effects of an A-bomb blast and those due to conventional high explosive bombs. The great power of the A-blast results in a unique destruction feature called *mass distortion* of buildings. An ordinary explosion will usually wreck only a part of a large structure, but the A-blast can engulf and flatten whole buildings.

Blast resistance. Some buildings are much more resistant to blast damage than others, due principally to basic design features and types of building materials.

The wind pressure effect of A-blast tends to push in and dislodge flat surfaces, like building walls which stand in the way of the onrushing blast wave.

Load-bearing walls. If the weight of the building rests on its walls, and even one of the walls is knocked out, the whole structure may come tumbling down. In Japan buildings of this type were destroyed at distances up to 6,200 feet.

Framed structures. If, on the other hand, the weight of the building is supported by an internal framework of steel or concrete columns and cross members, the structure will not fall simply because the walls are blasted away. For instance, many multi-story reinforced concrete frame buildings in Hiroshima and Nagasaki, particularly those designed to resist earthquakes, suffered remarkably little damage. Because the bomb exploding at 2,000 feet gives a powerful downward as well as outward push, roofs were seriously damaged, pushed down, left sagging or completely wrecked. Farther out from ground zero, where the direction of the blast was more nearly horizontal, there was less roof damage in proportion to lateral damage. In addition to roof damage, floors were damaged close to outer walls in the direction of the bomb burst, supporting columns of concrete were cracked or sheared off completely, and exterior walls on the side of the blast were dished inward.

Beyond 12,000 feet there was heavy damage to false ceilings, plaster and partitions. Brick and other building facings were blown off, even when the structures themselves were not seriously damaged. Wooden barracks at Nagasaki were destroyed at approximately 21,000 feet from ground zero and window panes were shattered as far out as 60,000 feet.

Steel frame buildings, such as tall office buildings and hospitals, should stand up even better than reinforced concrete buildings, since steel has somewhat more "give" than reinforced concrete.

Very tall American skyscrapers present an urban

construction type which is different from Japanese buildings. These large steel frame buildings are particularly resistant to blast, but at the same time they are higher and therefore closer to the bomb-burst itself. The facings of such buildings near the explosion would be blown off, leaving the frames more or less exposed.

Depending upon a number of features it is possible that the blast would blow right through a steel frame building, sweeping the occupants along with it, or that it would bend the structure to the point where it would be unusable. Most of such buildings of later construction have wide window areas and accordingly the occupants, if not sheltered in the core of the building, would be particularly vulnerable to flying glass and the effects of nuclear radiation.

Where there are large numbers of office buildings of this type of construction, as in New York and Chicago, the mutual shielding effect might be quite significant. The occupants of lower stories in such buildings probably would find quite safe shelter in the core of the building itself on the lower levels.

Industrial Buildings. In Nagasaki there were many steel buildings used for manufacturing, generally of the shed-type, some with saw-tooth roof design. Construction was generally comparable to that in the United States. Roofs and sidings were of corrugated sheet metal or asbestos cement.

Severe damage to industrial buildings occurred up to a distance of 6,000 feet. The first effect of blast was to strip off the siding and roof material. Close to the explosion the buildings were pushed over bodily and at greater distances they were in many cases left leaning away from the source of the blast. In general, steel frames were badly distorted and would have been of little use even if siding and roofing material had been available for repairs.

American steel industrial buildings would probably fare no better than those in Japan. The saw-tooth roof designed as rigid frames would be especially vulnerable to blast damage.

Shelters. Tunnel shelters, even near ground zero, survived virtually intact. Unquestionably deep shelters can provide adequate protection against anything but a direct hit.

Fire Damage

The intense heat shooting out in all directions from the explosion in the form of thermal radiation moves with the speed of light. Its effect is instantaneous setting fire to exposed surfaces at hundreds of points up to 5,000 feet from ground zero.

The blast wave, following a few seconds later, extinguishes most of these "baby" fires.

At the same time, the blast wave tears buildings to pieces exposing a vast amount of combustible materials —paper, wood, textiles, petroleum products, and gas from broken mains—the fuel for a vast fire.

The exposed combustibles are ignited at thousands of separate points by electrical short circuits, scattered coals from blasted furnaces of boilers, and cooking fires at gas stoves. Even buildings of fireproof construction catch fire when flying brands from burning buildings enter through broken windows and other openings.

These thousands of small fires flare up and spread out until they join other blazes forming a much larger fire. Each large fire widens its circumference until it merges with another large fire. And so the fires multiply and grow until soon the entire blasted area is one vast conflagration covering many square miles.

The conflagrations resulting from A-bomb explosion and old-style incendiary attacks are identical. In fact, they are much like very large peacetime conflagrations, except for size.

Within 20 minutes after one incendiary attack on Hamburg, two out of every three buildings were ablaze within a 4.5 square mile area. As the thousands of individual fires in this area grew in intensity, they combined to form a general conflagration which ultimately developed into a phenomenon known as *fire storm.* The tremendous amount of heat raised the atmospheric temperature to 1,472 degrees Fahrenheit at the perimeter of the fire. This super-heated air rose rapidly over an extensive area, and was replaced at its base by inrushing, cooler ground surface air. One and one- half miles from the fire this draft increased the wind velocity to 33 miles per hour. The tremendous hurricane of fire sucking in the air from all directions tore trees three feet in diameter out of the ground. As the temperature of the atmosphere reached the ignition point for all combustibles, the entire area was ablaze. In such fires complete burn-out occurred; that is ,no trace of combustible materials remained, and only after two days was the area cool enough to approach.

In Hiroshima, the resulting conflagration developed into a fire-storm, as it did in Hamburg. The resulting hurricane blowing into the burning area from all directions reached a velocity as high as 40 miles per hour within three hours after the explosion and did not substantially decrease until almost six hour later. This extensive movement of air within the burning area spread the fire to virtually every combustible object and resulted in a total burn-out of the area affected.

Firefighting. Firefighting experts are agreed that most modern fire departments would be unable to cope with the conflagrations resulting from A-bomb attack.

In Japan fire departments were completely over-

whelmed. In Hiroshima 70% of the fire fighting equipment was crushed in the collapse of fire houses, 80% of the firemen were unable to respond, and only 16 pieces of fire equipment were available to fight the vast conflagration. Even fire companies which had escaped destruction in outlying areas were unable to approach closer than 6,500 feet to ground zero at Nagasaki because of the debris clogging the streets. It was inevitable, therefore, that small buildings within this range would be destroyed. Even if the fire fighting equipment had been able to get much closer to the fires it is doubtful that it could accomplish much because there was no water pressure, owing to the destruction of water pipes and mains, from direct and indirect effects of the blast. Neither natural nor man-made fire breaks were very effective in preventing the fires from spreading because fires started simultaneously on both sides of the fire breaks.

Also, the superheated atmosphere forms a wall of heat several hundred feet thick around the circumference of such conflagrations, which prevents firemen from getting close enough to apply water to the flames.

When a fire reaches such dimensions, it is impossible in any event to attack individual fires. The basic strategy of the fire command is to contain the conflagration within as limited an area as possible and wait for the blaze to burn itself out.

The resulting desolation, extending for miles in every direction, is horrible to contemplate and represents almost incalculable damage to industrial production, and to a nation's power to carry the war back to the homeland of the enemy.

The summary report of the United States Strategic Bombing Survey on Germany indicates that the three incendiary air raids on Hamburg, July 24 to August 3, 1943, created what is believed to have been the worst holocaust in history up to that time. These attacks destroyed 55% to 60% of the city, damaged an area of 30 square miles, completely burned out 12.5 square miles, wiped out 300,000 dwelling units and made 750,000 people homeless. Many industrial plants were severely damaged.

No subsequent raid shook Germany as did that on Hamburg; documents show that German officials were thoroughly alarmed and there is some indication, from interrogation of high officials, that Hitler himself thought that further attacks of similar weight might force Germany out of the war.

On the basis of the experience gained in bombing Germany, our aerial campaign against Japan concentrated on incendiary bombardment. The 20th Air Force sent 79 missions against 65 cities in the Japanese homeland from March to August, 1945. In these attacks 93,000 tons of incendiary bombs were used but only 650 tons of high explosive and fragmentation bombs. Average destruction of these cities amounted to 50%. Many qualified analysts feel that fire won the final battle of Japan, even before the A-bomb was used. [8-4]

Knocks Out Utilities

The various public utilities and similar services on which urban life and industrial production alike depend are all likely to be knocked out for varying lengths of time by an atomic explosion.

There are wide differences, however, in the degree of damage to various utilities services depending on the type of facility under consideration, distance from ground zero, and design and layout of the local installation.

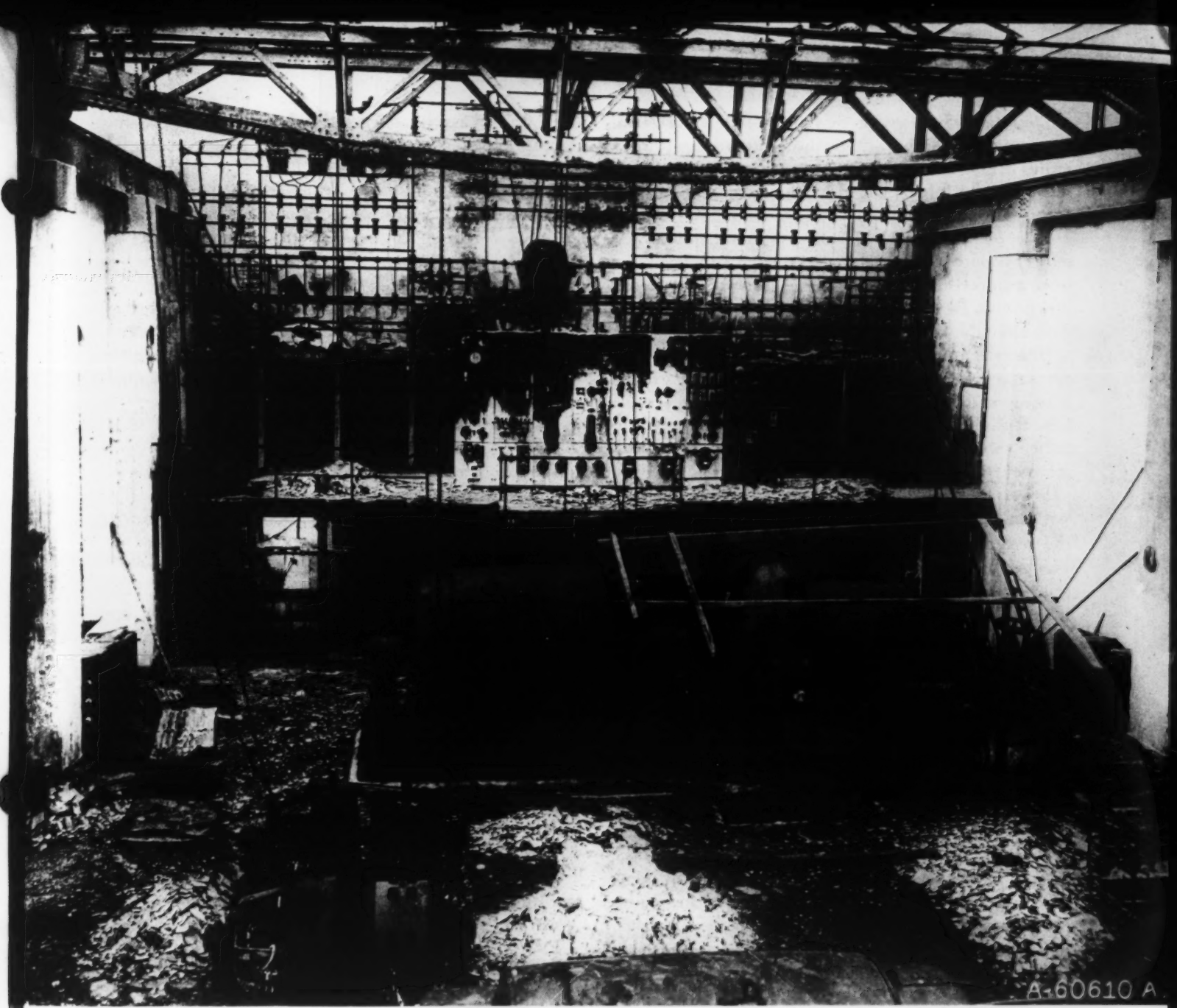
Some idea of what may be expected can be gained from a cursory review of Japanese experience.

At Hiroshima all utilities and transportation services were disrupted for varying lengths of time. In most cases, however, the demand after the disaster fell off even more precipitately than the available supply, and where the service was needed it could usually be restored at a minimal level.

Electric Power. In Hiroshima electric power from the general network was available in most of the surviving parts of the city four days after the attack and only one industrial plant was hampered in its recovery by inability to obtain sufficient power for several weeks. Utility poles were destroyed by blast or fire and overhead utilities were heavily damaged at distances up to 10,000 feet. Underground electrical conduits were little affected. Switch gear and transformers were not damaged directly by blast so much as by secondary effects, such as collapse of structure in which they were located, or by flying and falling debris. Motors and generators were damaged by fire.

At Nagasaki electric power distribution and transmission systems were effectively destroyed in the areas of heaviest damage but power could be supplied to the other parts of the city almost immediately.

Electric power service in most American cities will not be easily interrupted for any long period of time. Electric generating machinery is heavy and the vital parts are protected by nature of the design. Peacetime operating practice usually provides for automatic use of alternate facilities in case of outage in any one installation. Where feeder lines are underground there is not too much chance of damage, except very close to



U. S. AIR FORCE PHOTOGRAPH

Sub-station of electric power system at Hiroshima

ground zero. The "grid system" of feeder lines permits use of alternate lines into an area to replace those destroyed. Most electric power companies have excellent emergency repair services in peacetime, and take pride in the speed with which service can be restored after any disaster. Finally, many public utility systems have developed industrial defense plans which provide for the emergency installation of power lines in a stricken area until permanent service can be restored.

Gas. At Nagasaki both of the city's gas holders were ruptured and collapsed, and it was estimated that it would take several months to replace them. Gas holders were severely damaged by blast at 6,600 feet. The escaping gas was ignited but did not explode. Gas mains were undamaged.

Water Supply. In Hiroshima the water reservoir which was of reinforced concrete and earth cover was undamaged; it was nearly two miles from the blast center. However, 70,000 breaks in pipe connections in buildings and dwellings were caused by blast and fire effects. No subsurface pipes were crushed and no leaks resulted from blast as a direct cause, although several leaks in underground mains resulted from falling debris. Pressure dropped to zero because of the connection breaks and the damage to water mains where they crossed damaged bridges.

Sanitation. Six sewage pumping stations in Hiroshima were knocked out by fire and blast within a radius of one mile. The city's remaining eight stations were only slightly damaged but no effort was made to repair or operate them.

Telephone System. In Hiroshima the telephone system was approximately 80% damaged. Telephone poles were snapped off at ground level, carrying the wires down with them. No service was restored until nine days after the bombing attack.

Generally speaking, telephone lines above ground are very susceptible to blast damage; below ground they are rather safe. Most American phone companies have excellent repair and replacement arrangements which should insure rapid re-establishment of at least temporary facilities shortly after an attack.

Street Traffic. The extent to which American streets will be clogged with debris depends on width of the street and other open spaces between buildings, heighth of buildings lining street, and type of prevailing construction. In heavily built up business areas, lined with tall buildings on narrow streets, rubble and debris could pile up to a height of fifty feet or more. Even if all earth moving equipment, including bulldozers and power-shovels were to be put to work on clearing streets, it might be weeks before all streets are again passable.

At Nagasaki, trolley service was halted by the interruption of power supply, damage to street cars, and blocking of streets by debris. The day following the attack, police and industrial workers began the imperative task of clearing roadways. Only rakes and shovels were available for clearing the streets, which were filled with tiles, bricks, stones, corrugated iron, machinery, plaster and stucco. Street areas affected by blast and not by fire were littered with wood. Throughout the devastated area the wounded had to be carried by stretcher; motor vehicles could not get through the cluttered streets for several days. The streets themselves were not materially damaged by the bomb.

Railroads. At Hiroshima through railroad service was possible two days after the attack but fire trucks had to be used to pump water into the locomotives because of insufficient water pressure. At Nagasaki, major damage was sustained by track and railroad bridges. The rails buckled intermittently for a distance of 5,000 to 7,500 feet from ground zero at points where burning debris set fire to wooden crossties. The tracks had to be completely rebuilt. Railroad stations were annihilated by blast and fire. Rolling stock, however, was only slightly damaged, primarily by fire. Traffic was severely curtailed for 48 hours, during which time enough emergency repair work was done to let limited traffic be resumed.

Kills Human Beings

Unhappily for mankind, the atomic bomb is primarily a weapon to destroy population. It is more economical when used against civilians than against military personnel because civilians are usually bunched together in a higher ratio of persons per square mile than soldiers in the field.

Types of Casualties

The atomic bomb produces three main types of injuries on a human body, corresponding to the three principal physical effects of nuclear explosion.

Physical Effect	*Type of Injury*
Blast	Trauma*
Heat	Burns
Nuclear radiation	Radiation illness

Still another type of personal injury is psychic damage, especially the panic effect, which results partly from the violent physical phenomena and partly from the sudden and total disruption of the customary environment of the individual citizen.

Trauma

Wounds resulting from the A-blast fall into two categories:

direct—resulting from the pressure wave of the explosion striking the body with such violence as to cause injury to lungs, stomach, intestines, and eardrums.

indirect—caused by the collapse of buildings on personnel, by flying debris, and by the impact on living human bodies of being slammed against stationary objects.

Many direct blast injuries occurred in World War II from large scale air raid bombardment using conventional high explosives bombs. At Nagasaki and Hiroshima, however, the direct blast effect was not a significant primary cause of fatalities because most of those near enough to the explosion to suffer injury in this manner were burned or crushed to death. Beyond 1,000 feet from ground zero, it is unlikely that this effect was of sufficient importance to be a direct cause of death or serious injury to many persons.

The secondary effects, due to collapsing buildings

* Any injury to the body caused by violence; a wound.

and to timber and other debris flung about by the blast waves were much more important.

Glass fragments penetrated the skin easily and the light summer clothing worn at the time offered little protection. No information is available on the per cent of injuries of this type at various distances from ground zero, but persons up to 12,000 feet from the center of the blast were treated for laceration.

Shock was a serious complication in many cases.

Burns

Burn injuries resulting from an atomic explosion fall into two categories:

flash burns caused directly by thermal radiation,
flame burns caused by the numerous fires started by the explosion.

Although the flash heat from thermal radiation lasts but a few seconds it is so intense that it burns unprotected human skin at thousands of feet from ground zero.

In Japan, flash heat charred corpses beyond recognition in the immediate area of ground zero. Serious or third degree burns were suffered by those directly exposed within 4,500 feet. Few burns received beyond 10,000 feet required treatment. No flash burns were of any significance beyond 13,000 feet.

The flame burns resulting from city fires started up by the explosion are identical with burns received from usual peacetime causes.

Since the conflagrations started in Hiroshima by the A-bomb and in Hamburg by incendiary bombs were identical, and we have more detailed information on the Hamburg fire storm, it is instructive to look at the fire effects of aerial bombardments on the citizens of Hamburg who constituted the principal target.

In Germany, medical commissions, working under the Air Ministry, studied all causes of death and injury peculiar to aerial warfare, and performed over 20,000 autopsies. The summary report of these commissions stated that the greatest single cause of death was heat, directly or indirectly.

Hamburg was much better supplied with shelters than Japanese cities, and at the time of the Hamburg fire attack on July 27, 1943, there was time for everyone to go to a shelter or bunker and thereby evacuate the streets. Nevertheless, the loss of life was very great. When the temperature of the outside atmosphere rose to over 1,400 degrees Fahrenheit, the heat permeated to every point in the burning area, even down into the deepest shelters.

In the course of hours the air in the shelters became very bad. There was not enough oxygen to permit matches to burn. Many persons became sick, vomiting, and losing physical control. Some simply relaxed, went to sleep, and never awoke. Ventilating systems brought in hot, smoky air instead of cool fresh air. In some shelters, a pile of bodies near the door indicated an attempt to escape. Bodies were often found lying in a thick, greasy black mass which was without doubt melted fat which had been rendered from human flesh by the high temperatures and then had coagulated on the floor as the atmosphere cooled down.

Hundreds of people were forced out of shelters and found that it was a race with death among flames, fire bombs, explosions, machine guns and falling flak. It was impossible to escape the all-pervading heat. Flames spurted through the streets and winds of hurricane velocity caught up with the terrified escapees and threw them to the ground. The heat consumed the victims' clothing, frequently dissolving them without actually causing them to burst into flames. Some found safety in the bottom of bomb craters and others found death by drowning when the craters filled with water.

A few hours after the start of the raid, the corpses had a peculiar aspect. They seemed blown up, lying on their stomachs. Later the bodies shrank to small objects with hard, brownish-black skin. Parts of the body were charred, often to ashes, and even disappeared altogether. Of the 60,000 or more persons estimated to have been killed, only 45,000 bodies were recovered. The rest simply disappeared in the holocaust. [8-4]

Radiation Injury

Radiation injuries are caused by the ionizing rays emitted by the bomb and the explosion's by-products. These rays penetrate the body and ionize living tissue, making it impossible for it to perform its natural function. More specifically, the ionizing effect of nuclear radiation weakens the body's capacity to form blood and to resist infection.

Those receiving a lethal dose of radiation may die in a few hours. A few may last as long as two to twelve weeks. The course of the disease from the moment of dosage to death runs through the following symptons: shock, nausea, vomiting, diarrhea, fever, loss of hair, marked depression, fatigue, delirium, coma, and finally death. Once pernicious anemia sets in, there is decreasing resistance to infection. Death comes from three to six weeks after exposure. Medical science can do nothing for those whose bone marrow has been destroyed by nuclear radiation.

Those receiving a moderate dose generally exhibit the same symptoms as those receiving a lethal dose, except that they pass through the peak of the illness without succumbing and generally are on the road to complete recovery by the end of the fourth week.

The importance of radiation injury and sickness has been greatly over-rated in the popular press. Actually

U. S. ARMY PHOTOGRAPH

Hiroshima apartment building 2600 feet from ground zero; high proportion of window area to total wall area permitted much of blast to sweep through building leaving the framework itself standing relatively intact

a maximum of 15% of the *fatalities* have been attributed to radiation compared with 50% for burns. Furthermore, it now appears that those who survive the effects of radiation injuries will eventually recover almost completely, whereas injuries from blast and burns can be, and often are, incapacitating for life.

Furthermore, a maximum of 15% of the *surviving casualties* at Hiroshima and Nagasaki suffered from radiation injury. And even this ratio was due largely to the fact that a much larger percentage of the population was out of doors and not shielded than would probably be the case in an American city.

Number of Casualties

Estimates of the number killed and missing at Hiroshima range from 70,000 to 180,000 with at least 70,000 injured.

While the factors affecting the number of casualties which might be expected from atomic attack will vary widely from city to city, we must not too readily discount the casualty rate which might be expected in an American city because of the teeming population of congested Japanese cities. American cities, too, have their depressed and crowded areas, and in addition we tend to build vertically, so that the density of the population is high in a given area, even though each apartment dweller may have more living space than his Japanese counterpart. For instance, the center of the city of Hiroshima, when the bomb was dropped, had a population density of 35,000 persons per square mile. Manhattan, on the other hand, has a population density per square mile of 145,000 by day and 76,000 by night. As a matter of fact, the population density in the eight

square miles of Manhattan below Columbus Circle is 460,000 per square mile during the business day.

Local civil defense authorities will prepare estimates of expected casualties based on surveys of local factors; however, here is one general estimate of the number of casualties to be expected from the explosion of a nominal atomic bomb in a high airburst without warning in daytime over an average American city with a population density of one per 1,000 square feet of ground area:

Total killed and injured	160,000
Dead within 24 hours	60,000
Casualties surviving first day	100,000
Walking injured	50,000
Stretcher cases	50,000
Casualties suffering from burns	60,000—60%
Casualties suffering from mechanical injuries	50,000—50%
Casualties suffering from radiation injury	15,000—15%

The total is more than 100 per cent because some casualties would suffer more than one type of injury.

Also the number of casualties would diminish with increasing distance from ground zero. The following table shows a general estimate of the probable percentage of casualties under the assumed conditions indicated above, at progressive distances from ground zero:

Radius in Miles	*Dead* %	*Injured* %	*Uninjured* %
0.5	90	10	0
1.0	50	35	15
1.5	15	40	45
2.0	2	18	80
2.5	0	10	90
3.0	0	5	95

Panic

The fourth personnel hazard from atomic attack—panic—may cause a great many casualties, or very few. Authorities differ and our information is inconclusive.

Nevertheless, it is certain that it *could* cause great damage—as it did in Hiroshima and Nagasaki. In those cities the primary reaction to the A-bomb was fear—uncontrolled terror—strengthened by the sheer horror of the destruction and suffering witnessed and experienced by the survivors.

The two typical impulses were aimless, even hysterical activity, and flight from the city to shelter and food.

The Japanese estimate that some 20,000 people died in Hiroshima from the results of panic alone. The people, unprepared either physically or mentally in civil defense matters, ran from the city wildly, and many were trampled, or rushed into fires, or were pushed off bridges into lakes and rivers to drown. Many fled into the hills suffering from radiation illness, removing themselves beyond the reach of medical aid.

Such a shattering event could not fail to have its impact on people's ways of thinking. There is no doubt that the A-bomb was the most important influence among the people of these areas in making them think defeat was inevitable. Twenty-eight per cent stated that after the atomic bomb was dropped they became convinced that victory for Japan was impossible. Almost one-fourth admitted that because of the bombing they felt personally unable to carry on; 40% testified to various degrees of defeatism induced by the atomic bomb.

Following the atomic bombings, the appearance of a single plane over a Japanese city caused a wave of terror in the populace, total stoppage of production, and more widespread damage than hundreds of planes had done previously.

Disrupts Community Life

The disruption of community life caused by large-scale bombardment is so deep, so pervasive, and so long-lasting as to defy description. The damage to buildings and to human bodies is more dramatic and is easier to understand, but buildings can be rebuilt, most of the injured can be healed, and the dead offer no problem. But the dislocation of every aspect of life in a large community strikes at the power of a civilian population to carry on the war. Even the mere threat of large-scale bombardment, whether with atomic bombs or conventional bombs, has a disruptive effect on community life.

The Strategic Bombing Survey reports make it clear that the atomic explosion paralyzed or destroyed all community and welfare services in Hiroshima and Nagasaki. The impact of the A-bomb shattered the fabric of normal, human activity and disrupted the organizations for handling the disaster. A high proportion of civic authorities and rescue groups were among the casualties. A mass flight from Hiroshima took place as persons sought safety from the conflagration and a place for shelter and food.

The extent to which community life would be broken up depends on many factors such as the number of A-bombs exploded, the size of the community, and above all, on how well the city has developed its civil

U. S. AIR FORCE PHOTOGRAPH

Interior gutted, concrete structure of Hiroshima City Hall still standing after atomic explosion

defense preparations to counteract just such a disrupted effect.

Evacuation. As soon as the danger of war becomes imminent, it is necessary to evacuate from the threatened areas large segments of the population which are not necessary for defense activities. Evacuation is required even though experience in Great Britain, Germany and Japan has shown that it is a large, complicated and costly operation which breeds a host of difficult social and psychological problems.

In Japan 8,295,000 persons were evacuated from the target cities to safe areas in Japan.

In Germany 4,885,000 persons were evacuated due to "air terror." The Bombing Survey Report states,

> The vast civilian evacuations affected every facet of German morale. . . [and] had morale consequences of a physical, social and economic nature not only for the evacuees but for their hosts, for the families that were left behind and for the general morale level of both the bombed and the unbombed areas. . . The disruptive effects of such mass movement and migration. . . are impossible of statistical calculation by the very nature of the chaos that accompanied them.

Even Great Britain, which was never subjected to aerial bombardment to any extent like that adminis-

tered to Japan and Germany, found it necessary to evacuate over 3,000,000 persons, with a resulting dislocation of social, economic and community life.

Local Government. The entire local government organization can be knocked out—public officials killed, municipal buildings demolished, records destroyed and the various public services paralyzed in varying degrees.

Medical Services. In Tokyo and the outlying localities there was a grand total of 857 first aid facilities, of which 449 were destroyed by the bombing raids. Their loss was responsible for the considerable but undetermined number of persons who suffered and died for lack of prompt and effective first aid attention. Of 275 hospitals designated for the more seriously injured air raid victims, 132 were lost. Medical personnel became panic-stricken and fled to the country. Of 8,900 doctors in practice before the bombing, only 2,200 were left in Tokyo at the end of the war.

In Hiroshima, of 200 doctors before the attack, over 90% were casualties and only about 30% were able to perform their normal duties even a month after the raid. Only three out of 45 civilian hospitals could be used.

Despite the disruption of the sanitary system and a lack of medical facilities, no epidemics broke out as a result of A-bomb attack, possibly owing to the disinfecting action of the extensive fires.

Mortuary Service. In Japan traditional methods of disposing of the dead were abandoned, and mass cremation in the open, or mass burial in common pits, was adopted. Some idea of the task faced by the mortuary service officials in Tokyo can be obtained by comparing the normal death rate of 200 to 300 a day in peacetime with the 80,000 casualties caused by the March 10, 1945 raid. It took 25 days after that raid to clear the ruins of the dead.

After the A-bomb attacks, the extreme confusion from fire, flight of the population, and destruction of official records, made identification of the dead and accurate count of the casualties impossible. The season of the year necessitated rapid disposal of the bodies. Mass cremation and mass burial were resorted to.

Emergency Welfare. Within 24 hours of the A-bomb attack on Hiroshima, people were streaming back by the thousands to seek relatives and friends and to determine the extent to their property loss. Road blocks had to be set up to keep out the curious and unauthorized. The bulk of the dehoused population found refuge in the surrounding countryside. Within the city food supplies were short and housing shelter virtually non-existent.

Paralyzes Industrial Production

But what is the net strategic effect on the war effort of this destruction of great city areas, the wholesale killing of private citizens, and the disruption of civilized life as we know it? To what extent would it reduce war production and the flow of materiel to military forces on the fighting front?

These are the key questions which must be asked by the military power which levels the attack, by the defending armies which depend on industrial production to launch the counter-offensive, and by the industrialist who must keep his plant operating if at all possible in the face of widespread destruction.

The vulnerability of the American factory to atomic attack becomes more apparent if we remember how highly complex, minutely integrated, and geographically concentrated our industrial system is.

In a more primitive industrial system there might be factories in ten different locations, each making, let us say, radio receivers. If any one factory is knocked out, 10% of production is lost.

In our advanced society, production is much more specialized. There is likely to be one factory assembling a particular type of radio receiver, but depending on nine other plants to supply components. If any one of the ten factories is knocked out, production stops entirely.

Furthermore, our highly efficient production system is much more dependent on special purpose factory machines which can account for enormous volume of production, but which make it difficult to shift production if the special purpose machine becomes inoperative.

Finally, American industry is highly concentrated in relatively few industrial areas, mostly in a dozen states in the Northeastern quadrant of Continental United States.

The net effect of these factors is that much greater damage to industrial production can probably be done by fewer atomic bombs than in any other country.

Now let us look at the vulnerability of the individual plant.

Each factory is part of the local community physically, psychologically and socially. An industrial enterprise brings money into the local economy and receives from the community and its population, manpower, police protection, electric power, local transportation, and a host of other services on which it depends to function. Cut off these basic services and the plant must

stop functioning, even if the physical plant itself is untouched. Likewise, if industry were to cease operations in most large communities, the city itself would wither. In brief, there is a basic interdependence between local industry and the local community. They are members of the same living, producing organism.

With this strategic framework in mind, let us turn our attention to the ways in which industrial production can be paralyzed by atomic attack.

First of all, the plant buildings can themselves be destroyed or so damaged as to halt production.

Secondly, equipment and supplies within plant areas can be injured beyond immediate repair.

However, this is not the most serious threat to industrial production because most factory machinery is comparatively resistant to both blast and fire.

In Hiroshima, highly combustible contents of industrial buildings burned completely, regardless of the type of structure, but the contents of machine shops and foundries suffered comparatively little damage. Damage to machine tools was caused primarily by flying debris in reinforced concrete sheds, by fire in wood-frame structures, and also by dislocation and overturning resulting from damage to the building structure itself.

In the Mitsubishi Steel Works at Nagasaki, hardly any of the machinery could be used immediately after the raid, but nearly 70% of it could be repaired.

Though a few tools were blown over by blast, almost all of the serious damage was caused by debris from damaged buildings. The extent and type of damage to machinery depended on the type of construction of the buildings housing them. In wood-frame buildings, 95% of machines were seriously damaged, but in reinforced concrete structures only one-third or one-fourth of the machines were seriously affected.

A third way in which industry may be paralyzed is through the death or disability of a large part of the working force. Employees may be killed, severely injured, or entirely preoccupied with damage to their property or loved ones, or they may have simply fled with their families from the devastated city.

Fourthly, necessary public utility services may be lacking, especially electric power, water, industrial gas, and commercial steam. In this same category is the stoppage of transportation service through damage to equipment and other facilities and blocking of roads and rights of way.

Fifthly, disruption of community life and lack of even minimum public services may simply make it impossible for employees to live and work in the area.

Sixthly, sources of necessary raw materials and other supplies may be cut off.

Finally, vital technical and economic services may be interrupted for an indefinite period. For instance, breakdown of banking and other financial services could bring production to a halt in many plants.

Effect on Production

Some idea of the over-all effect of aerial bombardment on industrial production in Japan may be gleaned from the following statistics:

	Drop in physical productive capacity
Oil refineries	83%
Aircraft engine plants	75%
Airframe plants	60%
Electronics and communications equipment plants	70%
Army ordnance plants	30%
Light metals	35%

In July, 1945, the last full month before surrender, electric power and coal consumption were 50% of the peak reached in 1944. Over-all industrial output was approximately 40% of the 1944 peak.

A Strategic Bombing Survey investigation of production in plants employing more than 50 workers in 39 representative cities of Japan indicates that production in those plants which suffered direct physical damage dropped 73% from peak output while production in undamaged plants fell off 46%. This seems to indicate that the indirect effects of aerial bombardment caused a sharp drop in industrial production even when the plants themselves were not damaged.

The Japanese High Command had made only limited efforts to provide for defense of industry against aerial bombardment. As a result industrial centers took a terrible pasting as indicated by the above figures.

In contrast, Germany developed industrial defense to a very high level of effectiveness and accordingly was able to maintain, and even increase war production from the beginning of the war until late in 1944 when the heavy aerial bombardment coupled with other causes finally forced declines in war production.

In order to attain this effect the Allied Air Forces dropped 2,700,000 tons of bombs, flew more than 1,440,000 bomber sorties. A maximum of 1,300,000 men were in combat commands, of whom 158,000 were lost in air action. It took this heavy effort on the part of the Allies to produce strategic results against an enemy which was fighting simultaneously on two major fronts and which had much less in the way of manpower and natural resources than we did.

The lesson is obvious: without well developed defense measures, a modern industrial system can be paralyzed in months. With adequate defense, war production can be maintained for a long time and make the final difference between victory and defeat.

CHAPTER IV

WE PREPARE OUR DEFENSES

WHEN PRESIDENT TRUMAN announced in September, 1949, that Russia had set off a nuclear explosion, it became clear that this nation must prepare to protect American cities from the tragic destruction described in the preceding chapter.

A primary question in planning such defense is *what are the likely targets for atomic attack,* considering all the major factors which the aggressor must consider in planning an attack.

No doubt the initial target plan would be based on the strategic objective of doing maximum damage to our capacity for developing and launching a full scale counter offensive.

Possible targets for atomic bombs fall into two main categories:

(1) targets of peculiar military importance such as inter-continental air bases, ports of embarkation, and government plants manufacturing atomic bombs—to name only a few;

(2) large industrial centers producing supplies and equipment for the armed forces.

Responsibility for organizing defense of targets in category one rests with military authorities.

Responsibility for organizing defense of targets in the second category rests on local governments and on industrial plants in the target area.

Thousands of communities in the United States contain factories producing war materials but less than 250 of these are likely targets for atomic bombing.

For one thing, intelligence sources indicate that Russia does not have enough bombs for all possible targets and probably will not have enough any time in the near future.

Furthermore, atomic bombs are expensive. The essential fissionable elements, Uranium-235 and Plutonium, are scarce, and any aggressor nation must therefore assess a target in terms of the amount of fissionable material it can profitably allocate to its destruction. Each target must be evaluated for its essentiality to the defending nation's war-making capacity.

The cost of delivering the bomb to the target is an additional factor. As the range of a bomber increases, relative payload decreases, and costliness of delivering the attack becomes greater. Furthermore, the longer the distance the bomber must fly the greater the danger of loss by interception or for operational reasons.

Thus, although modern strategy is based upon the belief that any area of this country can be attacked successfully, the staggering cost in material and energy of such an extensive attack would require that it be limited to the most important targets.

Studies made to date indicate that areas of industrial concentration of more than five square miles or urban concentrations of more than 50,000 population may be within the lower range of consideration as possible targets. Naturally, as the population concentration or industrial importance increases the probability of attack increases accordingly.

While it would be possible to launch a limited attack with a lone bomber carrying a single A-bomb designated for a particular target, it is more probable that the attacking force would be a large armada of long range planes including the bombers carrying the atomic weapons, plus specialized operational and command aircraft.

The attack might be timed to coordinate with a massed military invasion and occupation of Western Europe.

To be more specific let us assume that the planned attack will include 130 of the newer-type atomic bombs, each one 2½ times as powerful as the old-fashioned weapons used on Hiroshima and Nagasaki. Of these 130 bombs, 30 are designated for targets of special military importance and 100 for heavily populated industrial centers.

Our Lines of Defense

Now, what are our successive lines of defense against such threatened attack?

First, as has already been publicly announced, our air forces will attempt to paralyze by atomic bombing most of the large Russian industrial centers. This acts as a deterrent to attack, but cannot directly stop an

attack itself. Russia might decide to risk loss of much of her own industrial capacity in order to capture the productive capacity of Western Europe.

Secondly, as an attacking armada approaches the boundaries of Continental United States, it comes within range of the military air defenses assigned to protect our homeland. If everything works as planned, the approaching air fleet would be detected by radar and visual observation 150 miles or more from our boundaries. This would provide time for our entire continental air defense system to swing into action. Jet interceptor planes would take to the air from various bases located along the line of flight of the approaching fleet. However, since the jets carry only a limited amount of fuel and ammunition they must work very quickly, for by the time they get off the ground and find their quarry they can make only a few passes at the enemy planes before being forced to return to their home base again.

Thirdly, as the A-bomb carrying planes approached their target cities, anti-aircraft battalions would go into action. Our present 120 mm. anti-aircraft gun can reach 40,000 feet. But a bomber moving 400 feet per second at that height on a cloudy night is a very poor target for any ground based gun. The main function of the anti-aircraft defenses is to force the enemy bombers to fly above 40,000 feet.

The net effectiveness of these successive lines of defense has been summed up by General Hoyt S. Vandenberg, Chief of Staff, United States Air Force, in an article in the *Saturday Evening Post* [3-8] which reads in part as follows:

> The American people must realize it is impossible to amass or invent an absolute, impregnable defense against bombing attacks by a strong, determined enemy. . . . Should war come, we can be expected to destroy no more than 30 per cent of the planes making an attack in strength on the United States before their bombing missions are completed. And our preparations today are not yet beefed up to achieve even that figure. Even if we had many more interceptor planes and anti-aircraft guns, and a radar screen that blanketed all approaches to our boundaries, a predictable 70 per cent of the enemy's planes would penetrate our defenses despite the extraordinary valor and skill of our pilots.
>
> My estimate of a 30 per cent loss inflicted on an enemy air attack is based on the assumption that the raid would be made by at least 100 heavy bombers. . . .
>
> The RAF throughout the war destroyed slightly less than 10 per cent of the German planes that attacked England. . . .
>
> The average loss we suffered in daylight strategic strikes on Germany was less than 4 per cent.
>
> The bleak and blunt evidence of the last war proved conclusively that no bombing attack mounted in sufficient strength by the Americans, British or Germans ever was turned back by the most strenuous defensive action. The offense always has had a crushing advantage in aerial warfare, and there is no prospect that the balance will change in the foreseeable future.
>
> In the Atomic age, more than ever before, a strong offense is the best defense. An attrition rate of 30 per cent on their planes never would stop the Soviets from attacking us, and the United States Air Force is not fooling itself on that count. The awful destruction produced by one atomic bomb would compensate the Red aggressors a thousandfold for the loss of 30, or even 100, planes and crews.
>
> The grim contingencies must be faced squarely along with the urgent necessity for supporting a civil-defense program that can save countless lives in the event, God forbid, of an atomic bombing.

Once the attacking forces have arrived over their targets and released their A-bombs, there is nothing more that our military forces can do. The exploding bomb over an American city is a problem for the civilian community. This is the problem of civil defense.

Civil Defense Countermeasures

Countermeasures against the effects of atomic attack fall into five basic categories.

Space—as mentioned earlier the physical effects of atomic explosion decreases with distance from ground zero; accordingly, one atomic defense measure is to evacuate personnel, move equipment and relocate buildings outside of target areas and beyond range of blast. This is the most effective defense of all, but has definite limitations in practice.

Shielding—powerful as the A-bomb may be, it is still a finite weapon; the penetrating effects of blast, heat and radiation are limited even by the resistance of open atmosphere; but this shielding effect is much greater for dense substances such as earth, water, and concrete. A thousand yards in air corresponds in mass to about one yard in water, two feet in earth, or fourteen inches in concrete. Accordingly a basic defense measure is to interpose shielding of some sort between

the explosion and the persons or property to be protected; for example, air raid shelters for personnel, and concrete baffle walls around valuable equipment.

Controlling damage—the actual amount of damage caused by the blast can be limited through definite countermeasures: fires can be extinguished, trapped persons rescued, the injured given first aid.

Duplication of elements—even with the best of defense efforts some buildings will be destroyed, equipment damaged beyond repair and personnel killed. This can be compensated for by arranging in advance for alternate buildings, spare equipment, and lists of available replacement personnel.

Repair and reconstruction—obviously it is not possible to provide for total duplication of all personnel and facilities, but plans can be made for rapid repair of equipment, reconstruction of buildings, and medical service for injured personnel.

The effectuation of such countermeasures requires an enormous amount of research, planning, organizing, training, and equipping, all of which must be worked out over a period of months or years on a nationwide scale.

The Federal government announced such a national civil defense program in a 162 page book entitled *United States Civil Defense,* published in Washington in September, 1950. [3-7]

This book defines civil defense as *the protection of the home front by civilians acting under civil authority to minimize casualties and war damage and preserve maximum civilian support of the war effort.*

The national civil defense program contemplates very numerous activities but certain of the services are of distinctive importance, and can be identified here.

Air Raid Warning Service. The civilian air raid warning service is established to receive advance warnings of probable attack from the air forces and disseminate them to appropriate civil defense authorities for transmission to key officials, and the general public.

Evacuation. Evacuation in civil defense means the organized removal of civilians from any given area. The area may be an industrial plant, a city residential block, or an entire city.

Shelter Protection. Shelter is a broad term, including any type of protection of personnel against the immediate effects of blast, heat and radiation.

Warden Service. The warden furnishes local leadership for organized self-protection and is a bond between the people of the community and their civil defense organization. In times of emergency he, or she, becomes the official leader of the particular group for which he, or she, is responsible.

Radiological Service. After an A-bomb attack trained radiological detection teams will be sent into the damaged area to determine whether there is any radiological contamination, and to mark off affected areas so that rescue teams and other civil defense personnel may know which areas can safely be entered.

Fire Services. The civil defense fire problem is similar to the problem of fighting large peacetime fires, except that the magnitude is tremendously increased; accordingly greatly enlarged organization, personnel and equipment are required for effective defense.

Law Enforcement. The policeman's job is increased incalculably during any disaster, but particularly so when an A-bomb hits. Accordingly the peacetime police force must be augmented by volunteers, and regular police officers must be specially trained in the problems which arise under air raid conditions.

Rescue Service. The rescue service removes persons trapped under debris of demolished or damaged buildings. Since civil defense training teaches every citizen to try to reach shelter before the attack takes place, it follows that a considerable portion of the population may be trapped in shelters by falling debris, crushed structures, and other obstacles to egress. Thousands of persons can be saved if the rescue service can work fast and efficiently in getting people out of buildings before fire spreads too widely, before injuries become fatal, and before other potential hazards can take their toll of the trapped persons.

Medical Services. In order to cope with the consequences of an atomic attack, the medical facilities of any community must be augmented tremendously with additional personnel, supplies, equipment, facilities, and special emergency organization. This is perhaps the largest single problem of organized civil defense.

Mortuary Service. Since an atomic explosion will kill more persons than even the worst of peacetime disasters, special arrangements must be made in advance for prompt burial of bodies in the interests of health, efficiency, and morale.

Engineering Service. An atomic attack on a big American city will present emergency engineering problems of a magnitude not previously experienced in the United States. Essential services, such as communications, power, and water supply, would be disrupted, and debris by the tens of thousands of tons would fill streets and highways, blocking access to damaged areas.

Some of the more important pre-attack functions of the engineering service include the organizing of all local engineering equipment and personnel into emergency teams; developing emergency plans for safeguarding water, gas, electricity and food supplies; protecting sewage and waste disposal systems; developing protective construction; and general engineering advice to the other services.

U. S. ARMY PHOTOGRAPH

Hiroshima

During the period immediately *following* an atomic attack, the engineering service would be called upon to perform numerous engineering functions to facilitate the work of the other emergency activities such as assisting the rescue service with construction equipment to get to trapped persons, maintaining water supply for fire service, clearing away of debris, setting up firebreaks, removing hazards, and making quick repairs to roads, bridges, utilities, hospitals, etc.

Communications. The nerve system of civil defense is communications. In wartime existing communications systems can be heavily damaged or completely destroyed under heavy attack. Communications requirements in critical target areas would include facilities for communications between Federal, State, and local authorities; civil defense control centers; air raid warning networks; communications systems at local levels for transportation, fire police, rescue, warden, medical and engineering services; air-ground; and communications at all levels to the public.

Communications plans would embrace all forms of communications, including telephone, telegraph, facsimile, AM, FM, TV, radio, teletype, messenger, service, and other emergency communications facilities.

Control Center. This is essentially a command headquarters for receiving attack warnings and other information, and for the initiation, direction and control of civil defense operations during an emergency.

Transportation Services. In the event of war-caused disaster, transportation will be needed for (1) civil defense forces; (2) transport of seriously injured to hospitals; (3) transport of homeless to temporary billets, and (4) movement of food and emergency supplies, including water.

Emergency Welfare Service. With the instantaneous destruction of tens of thousands of homes and the personal possessions of their inhabitants by a single atomic explosion, upwards of 100,000 citizens may be left on the street without housing or adequate clothing; with no place to eat, wash or sleep, with no means

of transportation, and perhaps without money or the ability to care for immediate needs. An emergency welfare service is necessary to help reestablish families, provide emergency housing, food, and clothing, locate missing persons and care for infants, children, the aged, and the sick.

Public Information. Since the problem of defense against air bombardment is comparatively new in this country, it is essential that the public be kept fully informed on all aspects of the civil defense program, before, during, and after an attack and what the individual citizen should do to aid in the over-all program. The problem of public information extends from top to bottom, and through the whole breadth, of the civil defense program.

A very important part of the local public information program is the arrangements made for release of vital information following an attack in order to let the public know quickly the extent of damage and what the individual citizen should do in his own interest and to facilitate the work of recovery and rehabilitation.

Training. The conditions presented by atomic attack are so different from any previous experience of individuals or organizations that a vast training program is necessary to teach every citizen what he must do to protect himself, his family and his property, and to impart to the members of the various emergency services the knowledge and skills necessary to perform their specialized functions effectively.

Civil Defense Organization

Passive defense of civilian life and industry is the responsibility of established agencies of government at all levels: federal, state, and local. However, atomic defense is so radically different from the usual problems of government that a distinct emergency organization is required, which is composed of the established agencies of government reconstituted temporarily to perform their functions under conditions of public emergency, plus entirely new specialized emergency services.

Federal Civil Defense Administration

To meet the national civil defense problem the U. S. Congress in January, 1951, established the Federal Civil Defense Administration and authorized it to perform the following functions:

(1) prepare national plans and programs for civil defense of the United States;

(2) delegate appropriate civil defense responsibilities to other agencies of the Federal Government;

(3) provide for dissemination of warnings of enemy attacks to the civilian population;

(4) develop civil defense measures including best measures for treating medical effects of attacks, civil defense equipment and facilities, and shelter design;

(5) arrange for training programs for the instruction of civil defense officials and other persons in the organization in operation and techniques of civil defense;

(6) disseminate appropriate civil defense information by all appropriate means;

(7) assist and encourage states to negotiate and enter into interstate civil defense agreements;

(8) procure materials and facilities for civil defense purposes;

(9) make financial contributions to the states on the basis of programs approved for civil defense programs.

The Federal Civil Defense Act also created a Civil Defense Advisory Council to advise and consult with the Administrator with respect to general or basic policy matters relating to civil defense. The Council consists of thirteen members including the Administrator, who is Chairman. The membership of this Council consists of three governors of states, three mayors of large cities, a former U. S. senator, one labor representative, one educator, two newspaper publishers, and a management engineer.

The Administrator of the Federal Civil Defense Administration reports directly to the President of the United States, as does the Secretary of the Department of Defense.

Under the Administrator is an administrative organization in Washington D. C. designed to carry out the purposes of the Act. Responsibility for industrial defense functions is assigned to the Facilities Self-Protection Division which is part of the Technical Operations Office of F.C.D.A.

It is the administrative policy of F.C.D.A. to work through the state governments to the maximum extent possible, and to avoid dealing directly with communities or with individual industrial firms. Business firms should not contact F.C.D.A. directly until they have exhausted every effort to get satisfactory service from local or state civil defense authorities.

State Civil Defense

The state is the "field army" of civil defense. Its counties or cities are its "divisions." When one or more divisions are hard-hit, the remaining ones are sent in for support, over and above the capabilities of local self-help and mutual aid.

In addition, the State takes part in interstate planning and operations, and in collaboration with the Federal Government, to provide training programs, assume its share of financial responsibility, and determine the allocation of Federal funds, supplies and equipment to counties, cities and towns. The operating chain of command starts at the state level. The elected governor is responsible for civil defense operations in his state.

The state civil defense organization usually includes a civil defense director who manages civil defense operations, and co-ordinates civil defense activities (at the state level) with those of other states, and with the appropriate representatives of the F.C.D.A.

Most states have also a civil defense advisory council resembling the National Civil Defense Advisory Council.

Local Civil Defense

Each city or county is responsible for organizing and running its own civil defense program and for making arrangements with neighboring communities to send or receive assistance if attacked.

Each community's civil defense organization usually includes a civil defense advisory council and a local civil defense director who is responsible for (1) establishing and administering the local civil defense organization; (2) co-ordinating and directing the local civil defense activities of public and private agencies or groups; (3) formulating and negotiating mutual aid plans and agreements; (4) directing the development of civil defense plans and programs in accordance with the policies and plans set by federal and state agencies; (5) establishing in target cities control centers to serve as command posts during an emergency.

Area Operations

An atomic explosion over any one of this country's metropolitan centers would place a burden on that community far beyond its own resources, however well-prepared they may be.

A stricken city will need the immediate assistance of organized forces from outside its own boundaries. To accomplish this effectively the whole surrounding territory must be organized to make available all possible emergency help to mitigate the effects of the disaster wherever it may take place within the territory.

This fundamental policy is defined in the text, *United States Civil Defense* [3-7], as follows:

> "No city or metropolitan area can be expected to provide completely for its own self-protection or recovery after attack. In fact, such provisions are unnecessary and are less practicable in actual operation than a properly organized system of intercommunity assistance."
>
> "To make every critical target community completely dependent on its own resources would dislocate the national economy and jeopardize the rest of the defense effort. A system of support from surrounding areas within each state is far more realistic because it does not call for a tremendous procurement program or an unusual drain on men, money and materials. Instead, it provides for the organized use of existing equipment following the principle that location is more important than quantity. The strategy is to organize for this type of support on a nationwide basis."

Mobilization of support for a bomb struck community is divided into five types:

local organizations
mutual aid
mobile support
fixed support
military support.

Local organizations. Local civil defense services are organized not only to counteract the effects of atomic attack in their own communities but to be ready to move to the support of other areas if some community other than their own is struck.

Mutual aid. Every designated "critical target area" in the United States has, or should have, a correspondingly designated "mutual aid area" the outer boundaries of which extend from 20 to 50 miles from the critical target cities. All the defensive resources of cities, towns, or townships within these areas are included in the mutual aid program, the purpose of which is to make sure that all such resources are mobilized quickly, systematically, and effectively to counteract the effects of atomic explosion on any community in the area.

Mobile support. Even after full mobilization no critical target area can be expected to have sufficient forces for complete protection. Supporting forces outside of the mutual aid area must be organized and ready to move into the stricken district. Overall command of these mobile support forces is vested in the State civil defense authorities.

Fixed support will consist of emergency centers outside of critical target areas which will receive over-

flow of medical cases, feed and house evacuees, and provide emergency bivouacking for civil defense forces.

Military support will be provided upon request from governmental authorities by the Armed Forces to the extent that this will not interfere with active combat requirements.

In such public emergencies, civil authorities have power to commandeer all available resources whether publicly or privately owned to mitigate the effects of the disaster.

The entire area functions as a unit under central leadership. Only in this way can resources be fully utilized for the common good.

Every industrial plant must regard itself as an organic part of area operations and a constituent part of the local civil defense organization under conditions of atomic attack.

An Evaluation

All studies of the effects of aerial bombardment in civilian communities stress the extreme importance of developing civil defense measures long in advance of expected attack.

After studying the effects of aerial bombardment on Japanese cities and the relative effectiveness of air defense measures, the United States Strategic Bombing Survey stated that "optimum civilian defense measures can reduce injuries and fatalities to *one-twentieth* or less of the number that could be expected, were no such measures taken."

One qualified authority on the effects of atomic explosion, Dr. Ralph E. Lapp, writing in the *Saturday Evening Post* [3-1] expressed the opinion that more than 80,000 deaths might be expected from a single A-bomb explosion on an American city where there was little or no civil defense preparation, whereas the number of deaths might be kept down to 12,000 under conditions of totally organized civil defense. This estimate is based on the assumption that the Russians have developed an A-bomb 2½ times as powerful as the bombs exploded over Hiroshima and Nagasaki, that is, it would have an explosive power equal to 50,000 tons of TNT rather than 20,000 tons.

It is interesting to compare the relative importance of military air defense and civil defense in protecting the population in the United States from the effects of atomic attack, using General Vandenberg's estimate that a maximum of 30% of invading bombers would be intercepted and Dr. Lapp's estimate of relative number of deaths from atomic attack. See Table D.

Although the figures shown in Table D rest on broad assumptions, they are well within the range of reasonable probability, and show vividly the extraordinary difference that adequate civil defense can make in protecting the civilian population against enemy attack.

The figures in Table D emphasize only one type of damage inflicted by the atomic bomb: civilian death. Also of high importance are (1) the intense suffering of millions of additional citizens who would be

TABLE D

Comparative effectiveness of military defense and civil defense in protecting the civil population from atomic attack assuming (1) invading aerial armada includes 100 planes each carrying an atomic bomb designated for a population target; (2) atomic bombs used have explosive power equivalent to 50,000 tons of TNT; (3) all 100 atomic bombs reach target if there is no military air defense; (4) 70 atomic bombs reach target if there is military air defense of maximum effectiveness; (5) each bomb landing on target kills 80,000 persons if there is no civil defense and 12,000 persons if there is total civil defense.

	Persons killed	Persons saved by total civil defense
With no military air defense and no civil defense	8,000,000	0
With total military air defense alone (no civil defense)	5,600,000	2,400,000
With total civil defense alone (no military air defense)	1,200,000	6,800,000
With total military air defense and total civil defense	840,000	7,160,000

Relative effectiveness of civil defense over military air defense: $\frac{6,800,000}{2,400,000} = 2.9$ to 1

seriously injured; (2) billions of dollars of damage to property; (3) disruption of government and public service activities; (4) damage to our war production capacity and ability to launch a full-scale counter-attack.

There is a curious contrast between the relative importance of military air defense and civil defense, and the amount of money the United States Congress appropriated for these activities on the federal level for the fiscal year beginning in July 1952:

	Requested in federal budget	Appropriated by Congress
The Air Force	$22,750,000,000	$21,122,000,000
Federal Civil Defense Administration	$ 600,000,000	$ 43,000,000

Relative appropriations for military air defense over civil defense:

$$\frac{21,122}{43} = 491 \text{ to } 1$$

It is recognized that this comparison has limited validity for the following reasons: (1) the air force has the mission of destroying enemy power in the field, which only indirectly protects against atomic attack, as well as active military defense of Continental United States; (2) part of the financial load for civil defense should be borne by state and local governments as well as the Federal government; (3) there is not a necessary and exact mathematical ratio between effectiveness of any defense measures and the cost thereof.

Nevertheless the disproportion is so extreme, the American public should be given a complete explanation to assure them that there has been a wise division of money in this supremely important matter and above all that several billions of dollars in military appropriations could not have been saved by decreasing the appropriation for air defense by several billions of dollars and increasing the appropriation for civil defense by a few hundred millions of dollars with resulting *improvement* in security of American citizens from the effects of atomic attack, and the protection of American industry's power to continue to produce the war materiel necessary for all-out counterattack when the need arises.

The increasing urgency of this situation is pointed up by the Air Force's decision in June 1952 to place the volunteer Ground Observer Corps on a twenty-four hour basis in 27 states to guard against low altitude aerial invasion through the vulnerable perimeter of the country extending northward from San Diego, California on the Pacific Coast, across the entire northern border, and down the Atlantic Coast as far south as North Carolina.

In explanation of this decision, Thomas K. Finletter, Secretary of the Air Force, in a *New York Times* dispatch stated that while he was not trying to scare anyone, it was a cold fact that the Soviet Union had the capacity to launch a surprise attack which would result in "fantastic casualties."

General Nathan F. Twining, Acting Chief of Staff of the Air Force, at the same time announced that the Soviet Air Force could launch a 400 plane attack by four-engine bombers capable of striking at "all our major metropolitan industrial targets." He also warned against complete reliance upon the striking power of the Strategic Air Command, our global bomber force. He said that the ability to strike was postulated on the ability to defend.

If such tremendous activity, requiring the use of hundreds of thousands of personnel and the investment of billions of dollars for equipment, is deemed necessary to decrease the effectiveness of atomic invasion by 30%, should not some corresponding effort be made to protect American industrial communities against the 70% of the planes in the attacking force which will get past the cordon of military air defense and let fly their missiles of destruction on American citizens, homes and factories?

A highly important strategic factor in developing an adequate civil defense program is the effect such a program would have on the calculations of the enemy in mounting an attack. In planning a military campaign a general staff must realistically balance possible gains against possible losses. The more the defenders can diminish the prospect of military gain, the less likely they are to be attacked. The better our national civil defense program is developed, the less attractive we are as a target, and the less chance there is of our suffering atomic bombing.

If our civil defense effort could be developed to the point where it would convince the Kremlin that attack is not worth while on American industrial centers, a military victory would have been gained of incalculable proportions. In this way each community and each plant can take a direct part in shaping the Kremlin's decision to attack or not attack American cities with atomic bombs. The most successful civil defense program of all might be that which is never tested by an actual attack!

Part II

PRINCIPLES
OF INDUSTRIAL DEFENSE

CHAPTER V

STRATEGY OF BUSINESS SURVIVAL

IN THE COURSE of widespread atomic attack on American industrial centers, thousands of business enterprises will be damaged in varying degrees. Many firms, even large ones, will be completely eliminated as going enterprises with no hope of ever resuming business. Other companies will be able to keep going but only on the basis of radically reduced operations. Some firms will suffer only slight interruptions in production. And of course, a few firms, even in target areas, will escape completely unscatched.

The amount of immediate physical damage will be determined by the proximity of the plant to the atomic explosion and the structural nature of the plant itself.

But the extent to which this immediate physical damage affects the survival of the business as a going enterprise will be determined in large part by the efforts which top management has made to protect the corporation through development of an effective industrial defense program.

Scope of Industrial Defense

Industrial defense includes all the measures which can be taken by management to protect industrial facilities and services against the effects of enemy attack and preserve maximum industrial support of the war effort.

Industrial defense necessarily covers protection against *all types of weapons* which might be used directly against industry and *all effects* of such attacks, whether direct or indirect.

No business activity in the United States would be immune from *the indirect effects* of A-bomb attack. If a large number of atomic bombs are dropped on American industrial cities, there will be such a widespread dislocation of economic activities that all business will be affected, even those far distant from the actual atomic explosions.

No corporation is immune to these indirect effects by reason of *size or type of business* engaged in, and *no part of a business* can count on remaining unaffected. Damage to any one part affects the operation of every other part.

Industrial defense includes *all measures* which can be taken for the protection of industry by industry for industry. It is broader than the concept of "plant protection," which is simply the physical protection of industrial property and personnel. Industrial defense includes the non-physical measures designed to mitigate the effects of enemy attack on capital structure, insurance programs, company cash position, legal commitments, distribution and marketing arrangements, etc.

Industrial defense includes *both short range and long range* measures: those which can be installed to protect the corporate set-up as it is now operating and also those larger measures which require a substantial change in a company's present operations, such as moving a large factory to a non-target location, construction of an underground plant, or purchase of remote mining properties to protect source of raw materials.

Responsibility of Industry

The responsibility for maintaining any organization in existence is inherent in the function of the chief executive. This is particularly true in our free enterprise system. Every corporate management has faced an endless succession of natural dangers since the day the company first opened for business. And thousands of businesses fail every year, even in peacetime.

The threat of atomic attack is just one more danger to survival which corporate management must make provision for.

Passive protection of a populated area as a whole is the responsibility of municipal government through the local civil defense organization. But protection of individual business enterprises is left to owners or top executives of each establishment.

The federal government in its basic policy manual, *United States Civil Defense* [3-7], has stated explicitly: "Primary responsibility for plant protection rests upon the owners and operators under the principal of organized self protection. . . . Private managements are expected to provide the necessary protection for their property and operations."

To assist plant management in developing its internal defense in effective coordination with the local civil defense organization, the Federal Civil Defense Administration has published a basic administrative guide entitled *Civil Defense in Industry and Institu-*

tions [4-10]. This work is rather broad in scope covering hospitals, insane asylums, schools, orphanages, churches, and penal institutions, as well as business organizations, but it can serve as a useful starting point in studying the problem of industrial defense.

F.C.D.A. has issued other publications on a wide variety of civil defense subjects. Of these publications, those which are more closely related to industrial defense are listed at the end of this *Report* in the section entitled *Selected References on Industrial Defense.*

Outside of this general technical help, business management is largely on its own in developing effective defense against atomic attack.

There is an important qualification to be made in the rights and duties of the individual corporation in planning defense against atomic attack. It is free to decide *how* it will organize its own defense but it is not free to decide *whether* it will plan any defense. Each and every firm *must* develop some defense program, the extent depending on how important its work may be to national defense, how great the danger of damage may be, and how much the individual firm can afford to spend.

To fail to assume this defense responsibility is to invite the government to take control of this phase of business management and accomplish through regulations, orders, and statutes, what could be much better done through the normal processes of private business administration.

The Executive as Strategist

The fundamental reasoning on industrial defense strategy is the same as for military strategy, or for regular peacetime business analysis and decision making, falling naturally into four parts:

What is this thing worth?

How much does it cost?

How much can I afford to spend?

How can I get the most value for the amount spent?

The question of value can be measured by the objectives which an industrial defense program is designed to accomplish, namely, (1) to keep the plant functioning as a part of the national industrial war effort, (2) to safeguard the lives, jobs and morale of the employees, (3) to preserve the capital investment of the stockholder, and (4) to maintain the competitive position of the company in the industry.

National survival depends on enough plants surviving, as *producing* units after an attack to supply material for a counter-attack. This value is beyond measurement.

What is the life of your employees worth—intrinsically? Obviously here again we are dealing with values beyond measure.

And now as to cost. For one thing, one hundred per cent security is *physically* impossible. There simply are not enough construction materials, industrial equipment, and manpower to relocate and rebuild our entire industrial plant on a bomb-safe basis.

Absolute industrial security is impossible *financially* for most industrial firms, because the expenditure required would probably equal at least twice the entire cost of the existing plant. It is a rare firm whose financial structure could support such a program.

Complete safety is impossible *economically* in a free enterprise business system. In our kind of society a business firm survives, generally speaking, only if it contributes a product or service to the economy which is cheaper or better in some important respect than the corresponding product or services of any competitor.

If any one firm in an industry should allocate an excessive proportion of the annual budget to its industrial defense program, it would have to pass this added cost on to the consumer and eventually would find itself priced out of its normal market.

One good rule of thumb might be for a firm to allocate funds to industrial defense on the same basis as it spends money for insurance against any other threat to business survival, that is, by making a realistic evaluation of its actual atomic risk against the maximum amount which the individual firm can safely spend without endagering its cost-value-price position in the industry.

This natural economic limitation should become less restrictive as time goes on. As one firm after another in an industry gets its defense program under way, this particular cost of staying in business will receive recognition and acceptance by more and more firms which will reciprocally increase what any one firm in the industrial group can afford to spend.

Furthermore, the Federal Government through legislative and administrative regulations is tending to encourage far-sighted businessmen to develop their internal defense programs.

Finally, in the course of time direct Federal financial help may be expected for this activity, which in the last analysis ranks close behind military defense in importance to national survival.

In order to get the most out of money spent for industrial defense (which in itself contributes nothing to the company product), it is essential that the program be based on very thorough administrative research, planning, and control at every stage of development. Money can easily be wasted and time lost through hasty or careless programming.

The Three Phases

Strategic analysis of defense of an industrial firm against atomic attack can be conveniently divided into three phases:

Planning and development phase—from day planning begins until first warning of imminent attack is received; this phase includes preliminary study, research, planning, developing an emergency organization, securing equipment, installing protective construction, recruiting and training personnel, and conducting test exercises.

Disaster phase—from moment first warning "attack imminent" is received until immediate physical effects of the atomic explosion have been brought under control: fires extinguished, trapped persons rescued, injured given first aid and transferred to hospital, etc.

Recovery Phase—from the time physical damage has been brought under control until plant is again in normal production.

Each of these phases is totally different in character and dimensions and must have distinctive treatment.

Part of Area Operations

When an A-bomb explodes in an industrial community *all* the defense resources in an area must be used to the maximum to mitigate effects of the attack, regardless of whether those resources are publicly or privately owned. Under this concept it is obvious that any facility, and particularly any industrial plant, no matter how large it may be, must regard itself as part of the still larger civilian community in which it exists.

Necessarily an individual plant, and local officials, must work in close coordination, because in effect your survival plan is a part of the over-all defense plan for your area. This is not just a matter of maintaining good community relations. British, German and Japanese experience all show that the only way industry can operate successfully under the threat of air bombardment is through wholehearted co-ordination between all interests concerned.

If you are hit, you will be in need of all the outside help you can get. But perhaps no help can reach you. So plan on capitalizing to the maximum on your own internal resources.

On the other hand, local authorities will have the right to call on your plant for help, whether you like it or not—and their requests will actually be commands, backed by law and the police power of the state. If arrangements for this mutual aid are worked out in advance, both you and the community stand a greater chance of survival.

Such co-ordination may yield immediate and tangible benefits to your plant. Local civil defense officials can frequently offer valuable suggestions and thus save you time and money in developing your survival plan.

It is also important to co-ordinate your planning with other nearby industrial firms, even with your competitors. Agreements to exchange raw material, personnel, or use of equipment may be the vital factor enabling you to survive. In Great Britain there were cases where, for instance, one plant would lose its equipment and another plant its raw materials. By combining what each had left, they were able to maintain vital war production.

Study of peacetime disasters in the United States point up some valuable lessons in the widespread disruption of community life and services under disaster conditions and the importance of interplant cooperation for mutual protection.

Factory Management and Maintenance provided some highly enlightening information in a special article on the disaster plans established by local industry as a result of the costly Kansas City flood of July 1951 [4-2].

The *Factory* report states in part

"Here's some advice, right from plant operating men who've learned about disaster the hard way.

1. *Get into the right frame of mind.* Your attitude on disaster is about half the battle. . .
2. *Get insurance protection*—all that you can carry, if it's available. If not you'll have to do it the hard way—build up a disaster "kitty."
3. *Get excited over community disaster plans.* Nowadays Civil Defense is an important factor in such planning. But C. D. isn't especially set up to protect industry. It won't do industry's job.
4. *Get excited about your own plant's disaster plans.* Check the plans with Civil Defense people, of course, and with your local manufacturer's planning group, if you have one (which you should) . . ." *

The Kansas City experience pointed up strongly the importance of central emergency authority which can begin functioning as soon as possible after attack. The local civil defense director stated "we found that, much as we love democracy, there has to be a virtual dictatorship if you are going to be successful in a disaster such as we had." Top industrial executives in the area should take the initiative if necessary in seeing that such emergency authority is established and that local plants are prepared fully to cooperate with such authority when disaster strikes.

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*Reprinted from *Factory Management and Maintenance*, June, 1952. Copyright by McGraw—Hill Publishing Company, Incorporated.

Time Is Now

Large scale atomic attack on American industrial centers could come tomorrow, or next week, or next year, or never.

As long as the philosophy of International Communism is backed up by vast military forces ready to strike at a moment's notice, we cannot rest. No doubt there will be alternating cycles of hopes for peace and fears of war for a long time to come.

But development of effective industrial defense cannot be dependent on superficial emotional states no matter how widespread they may be. Good programming requires careful appraisal of the underlying strategic situation, and honest recognition of its long range implications.

It takes a long time to build an effective industrial defense program in a large firm—a long, long time. And meanwhile more and more A-bombs are being manufactured and stockpiled in the Soviet Union. We must build defenses which will make us unprofitable customers for atomic attack. The time to start is now; and now is none too soon.

CHAPTER VI

ORGANIZING DEFENSE OF AN INDUSTRIAL FIRM

INDUSTRIAL DEFENSE must take its place as an established part of corporate management for years to come and appropriate provision must be made for it in the organizational structure.

Generally speaking, usual company administrative practices should be followed in installing this new activity in order that the dislocation of customary ways of doing business may be kept to a minimum. At the same time certain important differences must be recognized arising out of the peculiar nature of the defense problem itself. For instance, the survival plan, including special administrative arrangements, must be worked out long in advance and should provide for maximum possible delegation of responsibility for executing defense measures under attack conditions. Once the bomb falls, there is no time to decide on policy or develop programs. Only pre-existing policy, plans, programs and procedures can be of any use.

In this area above all, the management maxim applies: "Centralized planning, decentralized operations."

Preliminary Study

A suggested first step in developing an industrial defense program is the preparation of a clear but brief statement of the firm's industrial defense problem and recommendations for the initial approach to a solution.

This preliminary study might cover the following points: (1) an estimate of the probability of attack near the company's plant as developed by local civil defense officials; (2) key problems the company might have to face in the event of such attack; (3) recommendation for the assignment of responsibility for managing the plant defense program to an appropriate executive including a description of his proposed duties; (4) recommendation for appointment of a Defense Advisory Committee, including a statement of functions and the types of staff members who should compose its membership.

The most appropriate person for this preliminary study would be the executive who has top level responsibility for planning organization, systems and procedures.

Defense Co-Ordinator

The Defense Co-Ordinator is the top corporate executive responsible for devoloping and carrying out the company's program for surviving the effects of atomic attack.

His duties include: (1) developing a detailed understanding of the defense of an industrial plant against atomic attack, especially as it applies to his particular company; (2) working closely with the Defense Advisory Committee and corporate executives in developing the basic defense program; (3) maintaining liaison with local public civil defense authorities and other companies in the defense areas on problems of mutual interest and particularly mutual aid in case of emergency; (4) executive direction of the corporate survival program; (5) co-ordinating installation of defense measures throughout all departments of the company; (6) organizing and training the defense services which will be responsible for carrying out those defense measures which are not assigned to regular peacetime departments, such as the warden's service; (7) assuming direct charge of defense operations under attack conditions; (8) initiating and coordinating operations to get the plant back into production immediately after an attack.

The qualifications of the Defense Co-ordinator include: (1) executive experience comparable with that of other company executives holding positions of similar responsibility; (2) capacity for personal leadership; (3) skill as a negotiator and co-ordinator; (4) training ability; (5) robust health; (6) emotional self-control under crisis conditions; (7) exemption from military service.

The Defense Co-ordinator is responsible directly to the chief executive of the company and it is up to him to take all the steps which the president himself would take if he were able to spend full time on the company's industrial defense program.

While the Defense Co-ordinator should work closely

with the Defense Advisory Committee, he should not be limited by Committee action. As a matter of fact, immediately on appointment he can begin taking positive steps to improve the safety of the plant without waiting for Committee review. Such measures include, for instance, supplying employees with pamphlets describing what each individual should do for his personal protection under atomic attack; such pamphlets are available in quantity lots from standard sources [16-6, 16-8, 16-9]; tightening up on regular peacetime fire prevention practices; and designating best available shelter space as indicated by preliminary survey of existing facilities at plant site.

Fundamentally, what the Defense Co-ordinator must do is *act;* what the Committee must do is *study, plan, recommend,* and *advise.* Eventually, as the recommendations of the Committee are reviewed and approved by management, they can replace the earlier provisions. However, it cannot be emphasized too strongly that the Co-ordinator must have direct executive responsibility for industrial defense in his company and is answerable to the chief executive for executing that responsibility.

Emergency Organization

One of the first steps in developing the plant defense organization is to write out the functions to be performed by such an organization in full detail. Initially this *Report to Industry* can be used as a check-list. As time goes on and experience develops, a more refined version can be developed, based on actual operating experience in your own company.

These defense functions, as described, should be grouped under logical headings, each of which will form a segment of the defense organization. Local factors determining organizational structure vary so extensively from one plant to another, it is impossible to recommend a standard organization. However, for demonstration purposes we have included a sample organization chart showing one possible arrangement of a plant's defense set-up (See page 46). It is desirable that wherever possible the defense responsibilities be assigned to regular peacetime departments and that no new organizational subdivisions be established unless absolutely necessary. Thus, if the plant has a regular paid fire department during peacetime, this should form the nucleus for the defense fire set-up. The same holds true for the medical service, and so on.

Under attack conditions the "defense organization" will include all departments of the company, both the regular peacetime company units and the special defense services. The entire corporate organization must concentrate on the problem of survival, and this can be accomplished efficiently only if it is unified under single executive leadership.

In any event, once organizational subdivisions have been tentatively determined for the emergency defense set-up, individual positions should be established, with job descriptions outlining duties of each position and qualifications for the incumbent.

The number of personnel required for each function will depend on many factors, some of which will be referred to in this *Report.* It is essential that every important position be backed up by at least two alternates.

The organization chart should be published in sufficient detail so that every employee who has any defense responsibility will know how he fits into the over-all organization. It would be well to release this organization chart as soon as possible, even though it is recognized that substantial changes may have to be made later, as experience indicates the need for revision.

In multi-plant companies similar organizations can be established in each plant. The defense organization in each outlying plant would be headed by a Plant Defense Co-ordinator, who would be responsible to the company Co-ordinator of Defense through the local plant manager.

Defense Advisory Committee

The purpose of the Defense Advisory Committee is to develop a comprehensive statement of all the measures which the company should take to insure its survival under atomic attack, and to help coordinate development of the defense program in all departments of the company.

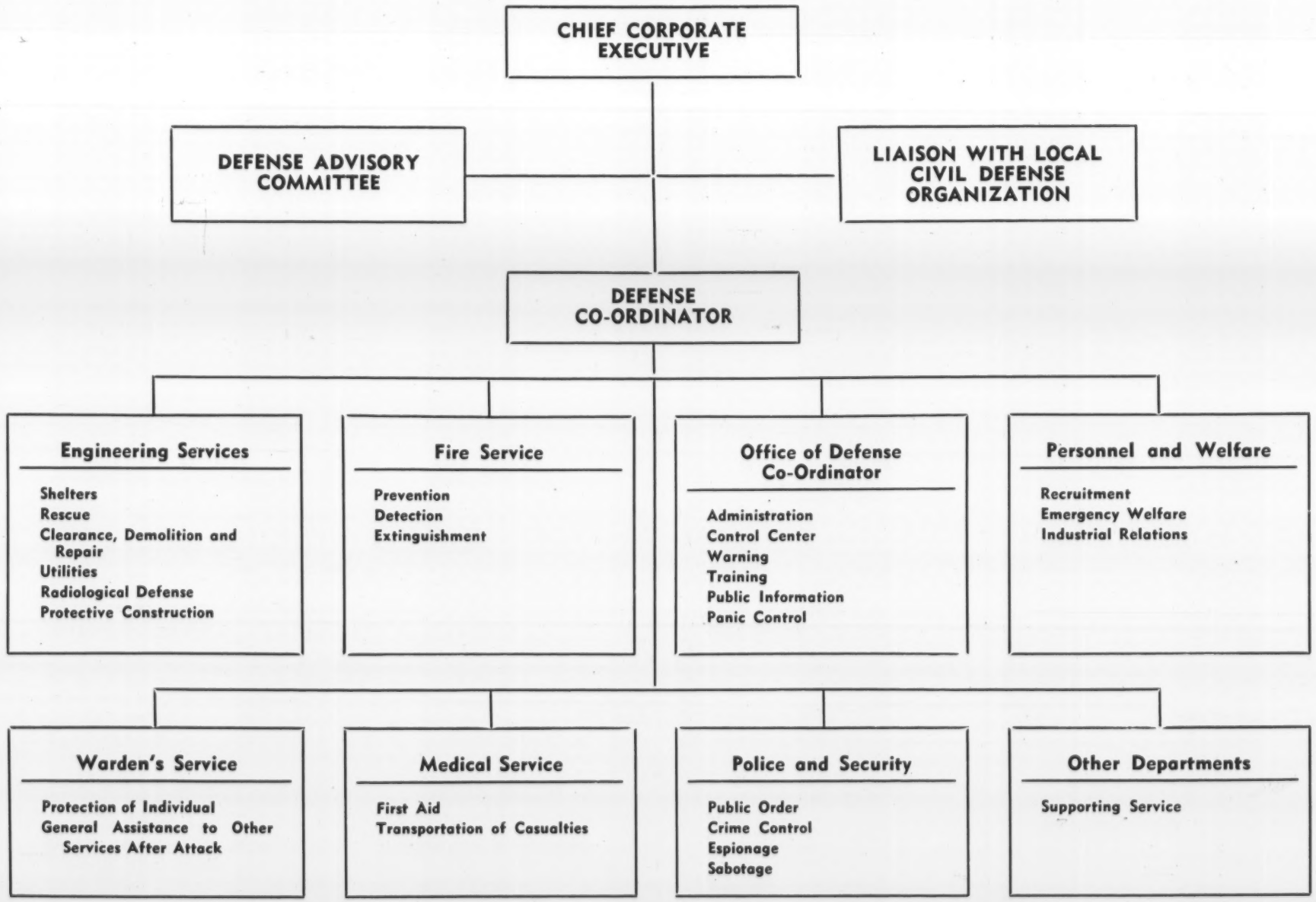
The Committee should be responsible solely to the President. It should not have "line authority," that is, it should not issue direct commands to any executive or organizational subdivision of the corporation.

The Committee should be composed of men who have among them all the skills, knowledge and experience necessary to prepare a comprehensive, thorough, and practical plan. It is particularly important that at least one committee member have extensive experience in administrative planning, technical analysis, report writing, and installation of new corporate programs.

Also included in the membership should be representatives of those company activities which would be most affected by the consequences of bombing attack, or whose co-operation will be particularly required in developing and carrying out an effective defense program.

It is essential that the committee membership include a recognized leader of employee groups. This might be the shop steward or some other union official.

Plant Emergency Defense Organization



The Committee should not be too large for efficient work, say no more than nine members. If it is necessary to bring in more than that number in order to give adequate representation to all company activities, it is better to form special subcommittees who will be responsible for particular phases of the over-all plan.

In multi-plant companies, separate plant defense advisory committees can be established at outlying facilities which will coordinate their work with the over-all Defense Advisory Committee.

In summary, the functions of the Committee may be described as follows:

(1) Gathering pertinent technical information on industrial civil defense;

(2) Analyzing the company's vulnerability to atomic attack in detail;

(3) Developing defense measures to mitigate the effects of such attack;

(4) Preparing a detailed written plan incorporating all of the measures which it recommends that the company take to insure its survival under atomic attack;

(5) Coordinating development and installation of protective measures.

CHAPTER VII

DEVELOPING THE SURVIVAL PLAN

THE FOUNDATION of a successful corporate defense program is a well-developed survival plan. A successful defense program based on a sound plan can raise the company's chance of survival in the face of atomic attack from one out of ten to nine out of ten.

The purpose of the company's survival plan is:

(1) to co-ordinate the thinking of those responsible for developing and executing defense measures;
(2) to make sure that all contingencies have been provided for;
(3) to test the practicality of proposals by subjecting them to appropriate review;
(4) to balance one proposed defense measure against another to insure proper emphasis in order of relative importance;
(5) to provide a basis for allocation of defense funds;
(6) to provide the chief executive with an effective management control device by which to measure progress in developing of the company's survival plan and program;
(7) to make official the company's participation in the national civil defense program since the government may, at a later date, require evidence of a company's defense program as a basis for tax credits, for allocation of war contracts, and for other purposes.

Coverage

The plan should include all the essential information, analyses and recommendations necessary to provide top management with a comprehensive understanding of the measures which must be taken to provide adequate protection against atomic attack.

All possible subjects should be disposed of, in one way or another, even when decisions are negative. For instance, if a large commercial firm close to the center of a very critical target area decides that nothing will be done about protecting office equipment, this decision should be recorded in the plan and not merely permitted to go unmentioned.

Research

For a complete defense plan, it will be necessary to do further research, and accordingly we have provided at the end of this *Report* a list of the more important publications which touch on problems of industrial civil defense. The Committee should establish some means whereby basic reference material is obtained, reviewed, and screened, with items of special interest being sent to individuals responsible for defense planning assignments.

Probability of Attack

The first important step in developing the survival plan is to determine how likely it is that an A-bomb will fall on or near your plant. You are in little danger if you are located in an area where the concentration of industry is less than 5 square miles or where the concentration of urban population is less than 50,000 persons.

As the concentration of industry or population increases so does the probability of attack. If you are within a *potential target zone,* as defined by the National Industrial Dispersion Program (see Chapter XV) your problem may be much more serious.

Your danger is greatest if in a large metropolitan area—not only because you are more likely to be in or near a target area but because fires are more probable and spread more rapidly in densely populated areas.

The Federal Government has prepared a confidential list designating 150 critical target areas as being either most important to the national economy or most likely to be selected by the enemy as profitable points to attack. Each state has been advised of the critical target areas within its jurisdiction. This list as a whole is restricted but state civil defense authorities are permitted to reveal the areas designated within their own jurisdiction to those who are responsible for important phases of civil defense planning. Accordingly, confer with your local civil defense authorities or write your state civil defense authority to determine whether you are in, or close to, a critical target area.

Such information will tell you only the critical target area as a whole. Actually, atomic bombs are not carelessly thrown into an area. Rather they are directed as precisely as possible at definite aiming points which are close to the center of the proposed area of destruc-

tion. Hence your chances of being hit in a danger zone are further increased if you are close to vital military, industrial, or transportation facilities.

Assessment of Vulnerability

Once *probability* of attack has been estimated, it is necessary to ascertain the *vulnerability* of your facilities to the effects of atomic bombs. This is a highly technical and tedious job, but it is a very important one. It is the step on which all later planning depends.

The atomic bomb, as we have seen, destroys or damages through the sudden release of energy in three forms: blast, heat and nuclear radiation. As the waves of energy expand in widening circles from the bomb burst, they collide with objects and produce a variety of physical effects depending on such factors as distance from the burst, intervening shielding, and the nature of the substances hit.

Using the technical data in the handbook, *The Effects of Atomic Weapons* [2-4], draw up a detailed inventory of the bomb's probable effects on every structure and installation in your plant area.

To carry out this survey of the bomb's probable damage, first prepare a map of the plant area and surrounding territory up to 100 yards beyond plant boundaries. This map should be on a scale of at least five feet to the inch and show terrain features, buildings, other nearby structures and installations, and such miscellaneous detail as may be of interest and use in developing the industrial defense plan.

Next, a damage probability form should be prepared which can be used to record in a systematic manner such information as the following on all company structures and facilities:

identification of structure: name, other common designation, exact location, relationship to other structures;

description: size, materials, shape, age, number of floors, exits, floor plans, and structural details; draw rough sketch of structure;

use: e.g., storage, light fabrication, office space, research, etc.;

occupancy: number of persons, occupations, shift hours;

utilities: location, load factors and other descriptive details with respect to electricity, gas, telephone lines, and the like;

service facilities: elevators, ventilation systems, cafeteria, etc.;

protection facilities: fire extinguishers, handpipes, hose outlets, fire alarms, first-aid stations, emergency exits, emergency cut-off switches, guard services;

potential shelter areas: use check-list provided in Chapter X;

blast hazards: effect of blast on structure, contents and human occupants, under varying assumed conditions;

fire hazards: effect of fire on structure, its contents and occupants, under varying assumed conditions;

radiation: shielding effect of structure in protecting occupants against direct radiation from atomic bomb;

special hazards: possibility of damage from indirect causes, such as release of noxious gases, spilling of dangerous acids and exposure to outside, nearby hazards.

A copy of this form should be prepared for each small building, and for each floor or section of larger buildings. Open areas of plant site should be divided into sections, and a form should be prepared for each such section, covering all structures and other installations, including fences, railroad sidings, underground utilities, and the like.

If possible, the damage probability survey should be supervised by a technically qualified specialist, such as a casualty insurance representative, safety engineer, fire inspector, safety engineer or professional consultant on the effects of enemy attack on industrial installations. If specialists in these categories are not available, the survey should be conducted by a member of the plant engineering staff with the most closely related qualifications.

This detailed description of probable physical damage is your assessment of vulnerability. It should then be made available to all who must co-operate in planning the defense of your plant, so that they may calculate the secondary effects which follow from the immediate physical damage.

As each damage effect takes place, it causes a still further effect in a continuing series. This cause-effect series must be pursued until the effects are beyond the scope of your activities. For instance, the blast wave may knock down a wall, which will start a fire, which will burn a file case, which will destroy accounts receivable, which will make it necessary to take some special action to protect the company against loss of money due from customers.

No general plan should be developed, or large amount of money invested in defense without this detailed assessment of vulnerability. It determines not only the nature of the countermeasures to be taken but the amount of time, money and human energy which should be invested in the defense of your plant.

Planning Assumptions

The detailed technical data contained in the assessment of vulnerability will probably be too voluminous and too complicated to be a usable working tool for all those who must co-operate in developing the company's survival plan. Accordingly, definite assumptions of probable damage should be established for planning purposes. Some sample assumptions are

- all officials of company killed
- all records of accounts receivable destroyed by fire
- corporate minutes destroyed
- 40% of office equipment destroyed
- source of essential raw material cut off by destruction of transportation lines
- one-half of goods in process destroyed by fire, leaving firm with unbalanced inventory
- no electricity available; plant otherwise intact
- employees refuse to come to work after A-bombing in another city because plant shelter unavailable or inadequate
- entire roof destroyed but production machinery unharmed
- 47 employees trapped in shelter covered by debris, local civil defense authorities unable to send rescue unit
- entire plant wiped out.

The assumptions should be selected on the basis of their practical value in completing a reasonable plan for defense.

Detailed planning should then proceed on the measures required to match the various assumptions decided upon.

Completing the Survival Plan

Recommendations from individual department heads should provide, first of all, for immediate steps which can be taken to provide some degree of protection as early as possible, followed by long range measures which may take considerable time to develop, approve, and install.

Long range measures, such as proposed new construction, relocation of plant, and building of underground facilities may take years to develop and carry out. For this reason we have placed these broader measures in a separate chapter, following discussion of the types of industrial defense measures which can be taken in terms of the existing set-up. Establish protective measures for existing facilities first, and then proceed to explore the problem of more basic solutions which over a period of time may provide better defense at lower cost.

The survival plan finally adopted should be regarded as a living document, continually changing to reflect improvements in the way of doing business. Rigidities are dangerous, inefficient, and bad for morale. As experience develops, and new technical information becomes available, numerous improvements in the defense set-up will suggest themselves. Progress and change should be the rule rather than the exception, even though each change causes momentary inefficiency.

In fact persistent emphasis on improvisation and expediency has an important operational value. No matter how careful your planning has been, the effects of a blast on your facilities may differ considerably from what has been anticipated. If, in the course of developing your plan, emphasis has been made on the development of basic operations more than on detailed procedures, it will be easier for the defense forces to adjust themselves to new and unexpected contingencies under emergency conditions, and bring the full force of available resources to bear on any problem which may arise, even though that particular problem was never discussed in the planning and development phases.

As each part of the survival plan is completed, a copy should be sent to the company chief executive, so that he may have at hand detailed knowledge of how the corporate defense program is progressing.

The company survival plan can serve as a master check-list for the Defense Co-ordinator under raid and post-raid conditions. This will help to make sure that all planned measures are carried out, especially if key personnel are killed and it is necessary to use on-the-spot substitutes.

A copy of the plan should be deposited in a safe place some distance from the plant so that it will be available for use as a guide in rehabilitation and recovery after the attack.

Before the corporate survival plan is too far along, it would be well to discuss its principal measures with local civil defense officials to insure effective coordination between your company plan and the general civil defense plans for the area in which your plant is located.

Because of the exceptionally complicated and novel problems involved in developing a corporate survival plan, many companies may find it to their advantage to hire professional consultants trained in industrial defense. Such specialists can frequently recommend defense measures which will cost much less than those otherwise planned, or which will give greater protection for the amount of money to be spent.

Part III

INDUSTRIAL DEFENSE MEASURES

CHAPTER VIII

CORPORATE ADMINISTRATION

THE TOP-MANAGEMENT group, including corporate executives, technicians, and professional men, with their supporting administrative staffs, constitute the most valuable industrial asset to be protected.

With this group intact, production of war material could be resumed in another factory at another location making the same kind of products. Without this group, production would be very difficult, whatever facilities might be available.

In peacetime, this corps of industrial managers and technicians is responsible primarily to the owners of the corporation. In wartime, however, their first responsibility rises above the corporation and takes its place at the highest level of national defense, along with our elected officials and military leaders.

The first A-bomb might seriously damage or destroy many industrial installations and the top-management corps of the affected firms would then find themselves on the front lines of World War III. The chief executive would occupy a position analogous to that of a military officer who commands troops in the field, and is charged with the defense of an organized position against frontal attack. And like a military officer, the first duty of the chief executive would be to the nation as a whole, sacrificing himself, his personnel, and the property under his control, if necessary to accomplish the final strategic results.

Generally speaking, top executives should stay at the plant site after an attack to help manage defense operations until damage is brought under control and only then returning home to look after their own families.

The nature of each executive's duty will vary widely. Strategic considerations may require, for instance, that the vice-president in charge of research take shelter as fast as possible after a warning in order to preserve his special technical knowledge which will be needed to help rebuild the plant in case it is hit. Another executive, say the vice-president in charge of marketing, might be assigned the duty of staying in the executive offices until the last of the employees is safe in shelter, since it may safely be assumed that marketing executives will be comparatively expendable under conditions of atomic attack.

Systems and Procedures

The root idea of systems and procedures is to determine by systematic research and analysis the best ways of doing business. This function is inherent in every enterprise under a competitive economy. But some of the larger and more progressive companies have established top-management planning staffs which concentrate full time on perpetual improvement of all corporate plans and methods.

Nomenclature for this activity varies from company to company and includes the following names: *business research, organization and methods, administrative planning, management engineering, management planning and control, economics control administration, methods and statistics* and, of course, *systems and procedures.* Each title refers to the same group of basic functions, but emphasizes different approaches to the problem.

The best time to determine the most effective working methods for a new corporate activity is before it gets well started, and accordingly the top management planning staff should be called into play as soon as the corporation begins development of its industrial defense program.

Four of the more important defense missions of the systems and procedures office are as follows:

1. prepare the survival plan report reflecting the recommendations of the Defense Advisory Committee as approved by management;
2. develop a complete record of all data necessary to reactivate the firm after a severe attack;
3. establish a program for physical preservation of corporate records;
4. provide management engineering assistance to all organizational units which are assigned planning or operating duties under the survival plan.

Survival Plan Report

The Defense Advisory Committee will of course

develop basic defense measures for review by top management. However, the drawing up of the actual report reducing approved recommendations to detailed working plans can be assigned to the systems and procedures office. This office usually has had considerable experience in developing important company-wide reports, including research, writing, editing, reviewing, and publication. The Committee will probably meet periodically, but the systems and procedures office functions daily and is accordingly in a better position to complete the exceptional amount of detail work required.

Company Description

Technical and managerial know-how is the sum total of the intelligence, knowledge, and experience of the executive and professional members of the top-management group. However, these men may be killed or incapacitated in an A-bomb attack, and it is essential that their technical knowledge be preserved to the maximum extent possible. A first step toward accomplishing this objective is to compile a complete description of all activities of the corporation, including present organization, financial structure, legal history, product lines and sales records, production activities, physical facilities, personnel and manpower, utilities and services, government relations, insurance policies, real estate holdings, stockholders' lists, basic operating procedures and all other data necessary to explain at a top level just how the organization functions and accomplishes its basic purpose.

Some material can be condensed from existing records, but much of this will have to be written down for the first time. Such information should be so complete that the top-management group of another corporation manufacturing the same product could come in and, with your company description at hand, reactivate your firm with a minimum loss of production to the defense effort.

This company description then takes its place with the other corporate records to be protected and preserved for post-disaster use.

Records Protection

Loss of important company records for many companies would be disastrous. Fortunately this problem has already received widespread recognition and excellent material has been developed on emergency records protection [5-1, 5-3, 5-5, 5-7, 5-9].

Even before the threat of atomic attack arose, the problem of record-keeping and record preservation had received concentrated attention of systems and procedures specialists in government agencies, industrial corporations, and business research foundations. This research showed that every large company should have a records management program even for peacetime reasons, since such a program pays for itself many times over, not only directly in lowered clerical costs, but also indirectly in improved records availability and in stimulating simplification of administrative procedures.

The first step in developing a corporate records program is to draw up a detailed inventory of company records covering the following points: (a) description of principal types of records; (b) purposes for which each record is prepared; (c) rate per week (or day, or month) new records are made; (d) volume of records stored; (e) location of records; (f) disposition of records; (g) cost of records handling and preservation.

Classify records on the inventory according to their importance to the corporation, under headings such as *vital* to company survival, *valuable* in preventing serious loss, *important* in maintaining company operations, *useful* in daily operations, and *unnecessary*.

Records should also be classified according to length of time they need to be kept: day, week, month, year, period of years, permanently.

Eliminate records which are unnecessary. Many records can be rendered unnecessary by rearrangement of operating procedures.

Records to be kept can be preserved in the form of handwritten sheets, carbon copies, punched cards, photo copies, or microfilming. Each method has its own value, depending on a variety of factors, which must be separately evaluated in each company.

Records which are to be kept over a period of time can be stored in your own vaults, in rented bank vaults, in branch offices, or in special archive centers established for the purpose and made available on a space-rental basis. Large corporations can frequently afford to establish their own records centers in bomb-safe areas.

Storage vaults of good construction placed below ground stood up remarkably well under bombing attacks in Great Britain, Germany and Japan—even under A-bombing. The chief loss was from water seeping past even tightly fitted vault doors. However, this problem is being studied by vault manufacturers and no doubt solutions soon will be available.

One important factor to consider in records protection is *availability* of records following a disaster. Those records which are needed right after an attack, for recovery and rehabilitation, should be readily accessible. And remember that files in an undamaged warehouse 50 miles away may actually be more *accessible* than records in a nearby vault covered with tons of debris. All bulldozers and heavy clearing equipment will be busy night and day on high priority emergency jobs, and it may be weeks or months before work can

begin on clearing debris from the vaults containing your records.

Management Engineering Assistance

The systems and procedures office should provide technical assistance to all offices and executives charged with developing sections of the over-all corporate survival plan. Such aid would include working out of operating procedures, drawing up layouts and flow charts, designing forms, developing training material, co-ordination with procedures of other offices, and helping in presentation of departmental recommendations to the Advisory Committee.

After the basic survival plan has been approved, the systems and procedures office can also provide assistance to departments and to the Defense Co-Ordinator in executing the measures provided for in the plan, including the working out of administrative details.

Fiscal Services

The survival plan should include a defense budget in two parts; (1) cost of defense preparations, subdivided into capital investment and operating cost, and (2) estimated cost of rehabilitation.

Cost of rehabilitation should be expressed in terms of various levels of expected damage to physical property, that is, 10% damage, 30% damage, 80% damage, etc. This is important in determining quickly whether to repair or rebuild plant property, and as a basis for obtaining whatever capital support might be necessary from the government or from private interests, to get the company back into production.

A simplified emergency accounting and auditing system should be developed in detail, and written up in manual form, to take care of at least the elementary requirements in the post-raid period.

All accounting records should be reviewed with the systems and procedures office as part of the records protection program, to insure that vital accounting records survive. In some companies, loss of current *accounts receivable* records could be disastrous. No matter how honest a customer may be, it may be impossible for him to pay his outstanding accounts because his own accounts payable records are destroyed and key personnel killed. In other companies, the paramount record to safeguard might be an *inventory of products* which are stored at widely scattered points or on the premises of other business concerns.

Offices which keep much currency on hand should make provisions to protect it from destruction or theft. Where circumstances warrant cash clerks might be allowed to carry currency to shelters—both to save it from destruction, and to insure that some company cash is available immediately after the raid.

If normal bank service has been disrupted by an A-bomb attack, currency shortage can create a serious problem. One safeguard would be to deposit currency with an outlying bank and set up emergency control measures for management of this cash until normal auditing safeguards are again operating.

A company checking account and credit position should also be established in a bank in another community in order to facilitate resumption of at least elementary banking operations until regular services are again available.

Study should be made of the possibility of obtaining government financial benefits for defense expenditures in the way of accelerated tax amortization and direct loans.

Section 124A of the Internal Revenue Code provides for the issuance of certificates of necessity to firms which meet certain defense requirements permitting a business concern to write off up to 100% of the cost of new plant and equipment in a five year period instead of the usual 20 or 25 year period.

A manufacturer contemplating new plant construction may obtain the standard application form for a certificate of necessity from any field office of the Department of Commerce.

Sections 301, 302, and 303 of the Defense Production Act provide for direct loans to industry in furtherance of the defense program.

Under the National Industrial Dispersion Program (see chapter XV) approval of certificates of necessity and loans in furtherance of defense production was to be based in part on determination of whether the proposed facility was to be located away from critical A-bomb targets.

RFC loans to finance projects for civil defense purposes are authorized for both public agencies and private borrowers under Section 409 of the Federal Civil Defense Act of 1950 (Public Law 920, 81st Congress). The total amount authorized to be outstanding shall not exceed $250,000,000. Such loans are made on terms and conditions prescribed by the RFC provided the maturities do not exceed fifty years. Under terms of the Act, the Administrator of Civil Defense must certify that each such project is necessary for civil defense purposes. Regulations covering such certifications appear in the Federal Register of August 22, 1951 as Title 32, Code of Federal Regulations, Part 1704.

The entire capital structure of the company should

be analyzed to determine what effect an A-bomb attack would have directly or indirectly on the capital position of the corporation. This review should cover all stock classifications, asset capitalization by categories, capitalization of intangibles, borrowed capital and other mandatory capital obligations.

Placement of surplus corporate funds should be reviewed to determine their availability to the firm for recovery and rehabilitation expenses after a nationwide atomic attack.

Insurance

Our peacetime insurance systems provide coverage for a wide variety of business hazards, based on long experience with assessable and measurable risks. The limits of potential liability are known and provided for. No mortal man, however, can express in actuarial tables the risk inherent in atomic weapons held by an unfriendly power, nor can any man predict the potential limits to the loss of life and property. One government agency estimates that a single atomic explosion over a major American city could cause property damage amounting to over two billion dollars.

Private Insurance

Since it is clear that all-out atomic warfare could result in damage claims greatly in excess of all available insurance company assets, the role of established insurance companies with respect to such losses is quite uncertain at the present time. Nor is it now known whether the Federal Government will underwrite such risks. (A beginning has been made in this direction as referred to below.) Until such policies are clarified it will be difficult to develop a corporate emergency insurance program.

Insofar as the individual firm is concerned at the present time, it would be well to tabulate all types of damage from expected atomic attack under standard insurance headings, including estimated value of probable loss. Next review all company policies to determine their applicability under war damage conditions. Expected damage not covered by adequate insurance constitutes your company's individual atomic attack insurance problem.

From time to time your inventory of emergency insurance requirements should be discussed with established insurance companies in order to get advice and up-to-the-minute information. Particular attention should be given to life insurance as a possible means for obtaining coverage on a variety of corporate A-bomb risks.

Government Indemnity

In 1951 the Federal Government announced that it was developing legislative proposals to meet certain rehabilitation and restoration needs of the civilian economy in case of successful enemy attack on American cities. Three aspects of this proposed legislation are of interest to industry.

Restoration and Rehabilitation. The proposed legislation gives the Federal Government authority to assist directly in the interim restoration of *essential war production facilities* in damaged communities. This assistance would be in the form of loans, grants, or advances to corporations for restoration and repair and, in the event that these measures do not suffice, to take direct Federal action to repair any industrial facility essential to national defense.

Moratorium. The bill also authorizes the President to impose a moratorium on insurance, retirement or compensation systems with respect to obligations arising from war causes in areas where war damage has been heavy, or the danger of such damage is imminent. The purpose is to allow all such systems and contracts to continue in operation with respect to their normal risks and to preserve the rights and interests of the normal peacetime beneficiaries. Under this Bill, the Federal Government could postpone settlement of war-caused claims if necessary, until the whole system has been re-established.

Property Indemnity. The purpose of this provision is to compensate for property destroyed as a result of enemy action. The bill authorizes appropriations of 20 billion dollars for indemnification of private owners of property destroyed or damaged by enemy action. The bill would authorize payment for not more than 90% of any proved claim for damage to private property. All proved claims below $5,000 and the first $5,000 of all larger claims—less 10% in each case—would be paid first. If the total remaining claims exceed the unused portion of the 20 billion dollars, the payments would be reduced by pro-rating the remaining funds.

This proposed legislation has failed to secure Congressional approval so far, but it is a virtual certainty that some legislation along these lines will eventually be approved.

Legal Problems

A-bomb attack could affect every legal right or obligation of a corporation.

Corporate counsel should review all contracts, other legal instruments, and rights and duties of the company, in terms of the planning assumptions stated in the corporate survival plan.

Even corporate charters and by-laws should be analyzed in light of the planning assumptions. For instance, it is important to determine what legal power the company would have to carry on its operations if all officers and members of the board of directors were killed.

Particular attention should be paid to the inclusion of escape clauses for both of the contracting parties in all agreements. Washington legislation may basically change many established legal relationships.

The Research Institute of America, in an Executive Policy Letter [4-8], provides the following information.

> Washington's legislative relief would be *retroactive* if a surprise raid occurred. The situations covered are likely to follow the pattern developed in Britain during World War II. . . .
>
> **Legal Relief for Debtors** . . . Contracts, leases, mortages, etc., would remain valid but enforcement of the rights under these obligation would be suspended for the duration: (a) where the debtor can show hardship due to the war, and (b) where the hardship arose *after* the deal was made. This type of relief would be modeled after Britain's Courts (Emergency Powers) Act and would apply in the following situations:
>
> *. . . Where a creditor tried to levy distress . . . take possession of property . . . appoint a receiver for any property . . . re-enter land . . . sell any security . . . seize a deposit . . . etc.*
>
> *. . . Where mortgaged property would otherwise be foreclosed.*
>
> *. . . Where a lessor sought to repossess land because of failure to pay rent.*
>
> In such cases, the creditor would probably have to get court permission before carrying out a judgment or taking other action to recover property. The courts would have the power to refuse permission, or grant it only conditionally. If a creditor disregarded the requirement that he get court permission before exercising his rights, a debtor could bring action for any damage sustained.
>
> **Aid on Informal Adjustments** . . . Washington probably will also develop machinery for lubricating compromises and informal adjustments, where business deals have fallen through due to developments that can be traced directly to the war. Relief is likely to follow the lines of Britain's Wartime Adjustment Act, which provided that any person in serious financial difficulties due to the war could apply to a "Liabilities Adjustment Officer" for advice and help which might smooth the way to a fair arrangement with creditors. The adjustor under such an arrangement is authorized to work out any kind of deal (lower rent, postponement of payment dates, changing mortgage terms, etc.). If London's approach is followed, the only provision would be that a majority of the creditors must agree. Any creditor who refused to go along with adjustor's scheme could appeal to the courts, but if the schemes were upheld, no further relief would be possible . . . the creditor's original rights would fall through.
>
> **Where Evacuation Is Ordered** . . . Special protection will be available. Here's how aid would shape up if the British model were used:
>
> 1. *A moratorium would be declared on all contractual obligations. The person seeking relief must show only that evacuation made fulfillment impossible.*
> 2. *No rent need to be paid as long as the evacuation order remained in effect. (But any rent that accrued before the evacuation was ordered would still be due.)*
> 3. *Charges for water, gas, electricity and phone service would be suspended.*
> 4. *Payments under installment plans would be suspended wherever a company ceased to do business in an area due to an evacuation order.*

Office Services

In general the office manager should develop evacuation procedures for the entire administrative staff and provide elementary office services on an improvised basis following a raid.

Raid Routine. In most offices not all employees could evacuate the building at the same time. Accordingly each desk should have a raid routine card listing the protective steps which can be taken by an employee before leaving for shelter—such as closing venetian blinds, placing protective covering over equipment, and moving office equipment to safer spots. All electric equipment should be turned off to reduce danger of short circuits.

Records in use at the time the warning sounds should be moved to the safest spot immediately available. In some cases, employees can put all important records in a vault on their way to shelter, with a vault monitor responsible for closing the door when all listed records are in. In other cases, the best protection might simply be to dump records in steel desks or file cabinets and

slam the door shut. A limited amount of exceptionally valuable current records which are light in weight can be carried by employees to the shelter.

It goes without saying that in any event the safety of the employees is more important than protection of company property or records.

Supplies and Equipment. Reserve office supplies and equipment should be stockpiled in a safe location. This can be accomplished by retaining, rather than selling obsolete equipment and buying stocks in advance of requirements. If actual equipment is not available after an attack it can be improvised: wooden horses and planks become desks; ordinary boxes can be used as files; pencils replace typewriters, etc.

A good supply of up-to-date forms should be kept at the records storage point for use until normal printing services are again available.

Office Space. In the post-raid period, some sort of headquarters must be established immediately. This space may be in a surviving building, in a neighboring plant, or even out on the open ground, or it may be possible to make arrangement for transferring the office temporarily to a company office in an undamaged area.

CHAPTER IX

PRODUCTION AND DISTRIBUTION

PRODUCTION and distribution management as used in this context covers the entire industrial process from the initial procurement of raw materials through all the processing stages an on to delivery to the customer of the finished product. In wartime the most important product is war materiel, and the most important customer is our armed forces in the field. A key factor in our strategy must be maintaining the continuous functioning of this industrial process.

Purchasing and Procurement

In order to develop adequate defense measures in the purchasing and procurement area it is essential first of all to have a detailed description available of all activities of the company in this area including at least the following information:

types of materials, supplies and equipment used in the course of a year
general specifications for each item
buying lot sizes
quantities purchased per year
frequency of purchase orders and normal delivery time
present supply sources by location
existing contract commitments to suppliers
methods of shipment for each type of material
chief purchasing problems encountered in World War II.

Once the above purchasing panorama is available, it should be analyzed in terms of what would happen to each activity if the planning assumptions of the survival plan should materialize.

Eliminating Items. Certain items used in peacetime may be eliminated through modification of product design or of manufacturing process.

Finding New Sources. Alternate sources of supply of the same raw material should be explored. If purchase orders are large, it might even be desirable to split them up into two or more parts, giving separate orders to suppliers in widely separated locations.

Use of Substitutes. If a supply of raw materials normally used is not available from any source, substitute materials can often be used, even though this might result in somewhat higher manufacturing costs or lower performance characteristic of the end product.

Stock Piling. Firms with ample storage space and surplus operating capital may find it a good investment to maintain a much larger stockpile of raw materials than peacetime practice would call for, especially of those items which store easily, may be kept in a safe area, and whose market value does not fluctuate sharply. Any such stockpiling must not be inconsistent with government regulation and the national welfare.

Mutual Aid Arrangements. Plants in the same area, which stock the same raw materials may find it advantageous to work out mutual aid agreements to share stock piles if necessary after an attack.

Reviewing Purchase Contracts. Review formal purchase commitments to existing suppliers to make sure that there are adequate escape clauses available in case ordered material can no longer be used, and to insure that delivery commitments will be enforceable in the highly competitive conditions which may follow disruption of the industrial supply system.

Emergency Procedures. Many peacetime purchasing procedures would paralyze the whole procurement operation if enforced under post-disaster conditions. For that reason it is wise to devise emergency procedures which would encourage purchasing officers to use maximum ingenuity and initiative in securing raw materials after an attack.

Warehousing, Storage, Inventory

Dispersal. Maximum practical dispersal of stored materials should be attempted as a basic strategy of defense. This applies to geographical dispersal—that is, keeping supplies of raw materials or finished products at a distance from the main supply—and to internal dispersal—that is, keeping stored material distributed around the immediate plant area.

It is important to disperse materials by product lines

rather than by types of material as much as possible. If a storage place containing the firm's whole stockpile of a given item is destroyed, production may well be halted. On the other hand, if each storage place contains a matched set of raw materials, the surviving storage point can feed a balanced meal to the production line and keep it going.

Inventory. Inventory policies and control procedures should be reviewed and revised if necessary, to allow rapid assessment of the supply situation after an attack, facilitate release of materials to production lines, and provide a reliable estimate of the raw material situation on the basis of which remedial measures can be worked out.

Also policy should be decided upon in advance regarding the type, kind and quantity of material which might be released to other companies to keep them going in the event their own supplies had been destroyed or were unavailable.

Physical Protection. Consult with plant architect or engineer and Defense Co-Ordinator to determine best method of physically protecting goods in storage.

Transportation and Traffic

Although all transportation facilities are easily interrupted by bombing attack, experience in World War II shows that limited transportation service can be restored rather quickly, if emergency operating plans are prepared in advance.

A detailed description of all traffic and transportation activities of the company should be prepared, covering at least these points:

- inventory of all types of goods moved to and from the plant, including raw materials; goods in process and finished merchandise; administrative traffic, such as mail and office supplies; personnel traffic including employees and visitors;
- volume of traffic by types, dates and periods of time (hour, day, week, month, season).
- types of carriers used, including railroads, airlines, barge and steamship lines, trucking services, passenger cars, municipal street facilities (streetcars, buses, subways, elevated lines), messenger service and company-owned vehicles.
- frequently used traffic routes including rail lines, highways, city streets, and traffic flow-lines within plant area;
- facilities other than vehicles, such as rail sidings, loading docks, shipping piers, cranes, etc.

The effect of A-bomb attack on the company's transportation activities should then be studied. The resulting analysis should be discussed with transportation officials and local civil defense authorities to determine what alternate facilities may be available after an attack and how the company's plans for emergency transportation service will be affected by the plans of the local civil defense organization. The municipal defense plan may provide for the exclusive use of certain routes for emergency vehicles. Unauthorized vehicles may be turned back, or shunted off the road.

Include in this analysis emergency transportation services which the corporate defense organization will require in the period immediately following a raid.

The Production Line

Generally speaking, production machinery survives the effects of bombing attack rather well. Nevertheless thoughtful planning and skillful management can help reduce the amount of production lost as a result of enemy attack.

Preparatory Measures. Peacetime planning and control methods should be reviewed, tightened up, and written out in detail, as a first step to developing emergency control measures.

An emergency production control plan should then be developed which will serve the production manager as a comprehensive check-list of the steps to be taken to meet the various anticipated contingencies and get back into production.

Blast hazard should be discussed with plant engineers and effective shielding should be installed where economical and feasible, to protect both machinery and workers.

Raid Routine. Each worker should be rehearsed in protective measures to be taken after the air raid warning has sounded, such as the following:

- turning off power
- lowering suspended parts to a position of rest
- removing delicate and valuable parts and placing them under heavy framework of machines or in other protected places
- placing mobile machines, such as traveling cranes and fork-lift trucks where they will sus-

U. S. AIR FORCE PHOTOGRAPH

Factory interior at Nagasaki

tain the least amount of damage and help to shield less sturdy machinery and equipment

- throwing tarpaulins or other protective covering over machinery, especially electric motors
- putting plant's blueprints, specification sheets and other necessary working papers in the safest spot at hand
- carrying fine inspection instruments and guages, and valuable hand tools to shelter to protect them from blast and fire damage.

Restoration of Production. All plant workers should be trained to work on removal of debris from machinery and plant floor areas immediately after a raid so that engineers and maintenance men can start emergency repairs with a minimum of delay.

A check-list should be prepared outlining the steps necessary to get each machine back into operation after an air raid. This should enable foremen and the more experienced workers to go a long way toward getting the plant back into production without using up the time of valuable engineers or endangering machinery. For instance, an electric motor that is choked with dirt may soon burn out when power is turned on, thus indefinitely delaying use of machinery, whereas thorough cleaning and checking of the motor according to written instructions may help get that machine into production again within a day or so after an attack.

Reciprocal sub-contracting arrangements should be made with other manufacturers in the area, using the same type of machinery, raw materials or personnel, so that the combined resources of the members of the mutual aid agreement can be pooled to assure maximum use of whatever production capacity remains available after a raid.

Plant processes should be checked to determine whether any of them can be eliminated under emergency conditions. Frequently older and simpler, though less efficient, processes can be revived if conditions warrant. Determine how much of your production equipment you could make, repair, or improvise, with raw materials and machinery available in the plant area or nearby, including molds, patterns, jigs and fixtures, dies, forms and the various consumption tools.

The big idea is to get production going again as quickly as possible. The same kind of ingenuity, technical skill and managerial ability which built the company in the first place should be brought to bear on the problem of getting back into production regardless of how bizarre the improvised methods may seem.

Marketing and Distribution

Product Lines. It should be determined which product lines can best be dropped or modified. Lines which have little importance to the war effort may well be eliminated. On the other hand, new lines may be added. Widespread property damage may percipitate terrific demand for new items which your firm could make, replacing discontinued lines.

Sales Territories. Provision should be made for realigning sales territories. It might become necessary to trade territories with distant competitors, assuming that government restrictions would not interfere under emergency conditions. In any event, limited production would probably lead you to concentrate on those territories which your firm can best service under wartime conditions.

Alternate Product Design. It might be well to develop alternate product designs, at least in semi-finished shape, so as to counteract such contingencies as loss of raw materials, the elimination of particular processes, or the loss of certain markets.

Keeping Salesmen. Many experienced, reliable salesmen left their companies during World War II because there was little or no selling to be done. Later both companies and salesmen regretted that they had parted company. Considerable effort should be made to retain loyal and productive salesmen in a substitute capacity until peace returns. Some of the functions which salesmen might perform include liaison with government agencies, public relations, training in plant protection, planning post-war marketing programs, and training newly recruited plant employees. If your salesmen do leave you for government service, you may find it to your advantage to grant them leaves of absence with reinstatement provisions.

CHAPTER X

ENGINEERING DEFENSE SERVICES

THE ENGINEERING group is responsible for certain technical aspects of the corporate survival plan, for providing the other defense services with advice and assistance, and for organizing some of the defense services.

The person appointed to be head of the Engineering Services may be the executive who is responsible for the most closely related functions in peacetime, or some other person of comparable responsibilities. Insofar as his defense functions are concerned, the Chief of the Engineering Services reports to the Plant Defense Co-Ordinator.

Shelters

Adequate shelters for industrial personnel are frightfully expensive, but they are absolutely *essential* to maintain production under conditions of atomic warfare.

Fortunately, they are highly effective. They do work. Every plant in a target area must establish a shelter *policy* and a shelter *program.* And the sooner the better.

As pointed out earlier, one defense against A-bombing is *shielding,* i.e., placing some substance between the object to be protected and the explosion to mitigate the effects of blast, heat and radiation. For human beings this means providing bomb-safe space in existing buildings, or in specially-constructed shelters.

The most instructive fact at Nagasaki was the survival, even when near ground zero, of hundreds of persons who were properly placed in crude earth shelters dug into the sides of small hills. The only support for these shelters was timbers bracing the entrance to the tunnel.

One such shelter was only 300 feet from ground zero when the atomic bomb exploded. Of 400 people in that shelter all escaped injury except a few who were standing near the entrance.

Similar shelters with a capacity for 75,000 persons were available throughout the city, but they were mostly empty. People had gotten into the habit of ignoring the air raid warning, did not bother to go to those shelters, and as a result 73,000 died, many of whom might otherwise be alive today. Carefully built shelters, though unoccupied, stood up well in both Hiroshima and Nagasaki. Without a doubt shelters can protect those who get to them against anything but a direct hit.

Industrial management must assume responsibility for providing shelters for their employees and for other persons who may be on their property at the time of an attack. In any event, many employees simply will not come to work during periods of threatened attack if adequate shelters are not available.

Dr. Martin Blank, a leading German industrialist and organizer of industrial air raid protection, emphasizes strongly the importance of a shelter program in maintaining production under attack conditions.

> ". . . day by day and night by night the attacking enemy waves roared over the Ruhr district and chased the scared population into the [shelters]. Day by day they saw the effects of heavy bombs . . . debris and ruins . . . fire storms . . . dead and wounded. No wonder that women and children, and even men, lost their nerve. And it was happening in the plants too. It is understandable that the cry for better protection was voiced at the plants as well and this better protection could be secured only by building [shelters]. Of course, the managers in industry had to comply with the demands for the sake of maintaining . . . production.
>
> ". . . the thought of having a truly bomb-proof shelter not only gives the workman the feeling of safety but it strengthens the bond of confidence between him and his protection organization and his . . . chief. It will also reinforce the worker's feeling of responsibility to stick to his post to the last possible moment and to return there as soon as he is called up from the shelters to help repair damage or to resume work." [22-2]

Not all workers can be protected, and no worker can expect complete protection, but each company must establish a basic shelter policy, based on the following considerations:

(1) amount of warnings to be expected,
(2) number of persons to be protected,
(3) relative importance of the war effort of the

U. S. AIR FORCE PHOTOGRAPH

Blast struck downward against the roof of the Chinzei School at Nagasaki. Fourth story collapsed completely, but the heavy construction protected machine tools on first floor from serious damage

various classes of industrial personnel.

(4) cost to company and to war production of providing varying degrees of protection.

Shelter Requirements

Here is a check-list of some of the principal factors to be considered in establishing shelters:

Location: as close as possible to the employee's work stations.

Space: *minimum*: four square feet per person; *normal*: six square feet; *luxury size*: thirty square feet. Air space should be a minimum of fifty cubic feet per person where there is natural ventilation.

Capacity: better to have numerous small or medium-sized shelters than one large space, so that destruction of any one shelter will cause only a limited number of casualties; a good average size would be fifty persons per shelter room.

Entrance and exits: At least two separate entrance-exits each at least 22 inches in width, but preferably 44 inches or more, for a shelter with a capacity of fifty persons. Ramps are better than stairs. To protect against direct blast-effect, heat-rays, and nuclear radiation, the entrance should have a heavy door, or a baffle, or a turn in the entrance passageway.

Structural specifications: shelters should be fireproof, resistant to collapse, and with adequate shielding against the blast, radiation, flying glass and debris expected at one-half mile from ground zero. Shelters

designed for a static load of 500 pounds per square foot with an earth cover of two feet would meet these specifications. Drainage must be adequate to protect against flooding from ruptured water pipes and rain. Shelters should contain no fixtures or objects which can be detached by shock and become flying missiles.

Ventilation: a minimum of 150 cubic feet of air per person per hour should be provided. If natural ventilation is not adequate it is necessary to install a manual or power-driven mechanical ventilation system.

Equipment: telephone; radio (battery-operated); lights (regular electric, plus emergency: battery-powered, self-contained generator set, or even kerosene lamps); benches; chemical toilets (one for each 25 persons of each sex); drinking water (one pint per person for each two hours of occupancy); emergency rations to last at least 24 hours; first-aid equipment; blankets; picks, shovels and crow bars to enable occupants to dig themselves out if necessary.

Shelter signs: directional signs should clearly indicate to all persons routes of travel to the nearest shelter area. Building entrances should be appropriately marked so that persons outside unaccustomed buildings will know how to get to the nearest shelter.

Shelter in Existing Structures

Frequently it is surprisingly difficult to find sufficient shelter space meeting all requirements in industrial structures.

Many modern factories are built on a single ground floor level which provides little usable shelter space. Many of the older industrial buildings are of load-bearing brick wall construction which would come tumbling down in a pile of rubble, covering any shelter space and its occupants. However, in such a collapse, rescue parties probably would be able to extricate the occupants alive if the shelter walls and roof were strong enough to support the load of debris.

A shelter area should be so located that there is a maximum amount of dense material between the occupants and the eventual bomb blast. Obviously, therefore, it should be close to the center or core of the building. There should be at least one interior stairway to permit egress in case the outer exit is blocked by debris. Give special consideration to elevator lobbies, rest rooms, stairwells, interior halls, basements, subways, tunnels and vaults.

Sometimes a shelter space can be used for a secondary purpose when attack is not imminent, such as recreation space, cafeteria, or meeting room. However, no space should be called a "shelter" if other occupancy in fact prevents it from being immediately available when the warning sounds.

Sub-standard shelter areas should be improved as rapidly as possible. If the supports, walls and roof of the shelter area will not support the collapsible load of the rest of the building they should be strengthened structurally.

Utility hazards such as boilers, furnaces and fuel storage tanks can be separated from shelter areas by masonry walls or their equivalents having a minimum fire rating of two hours. Steam, water, and gas mains can usually be housed to minimize danger in case of rupture.

Additional exits can be installed and glass substitutes used to eliminate hazard of flying glass. Where shelter is necessarily exposed to windows in outer walls, it may be possible to construct special blast walls.

Advice on the usability and effectiveness of potential but doubtful areas should be obtained from architects, structural engineers, builders (preferably nonresidential), fire insurance and rating personnel, and municipal building inspectors.

Fire

One of the most important defense responsibilities of factory management is the development of adequate fire protection in industrial plants.

With proper fire defense measures, such holocausts as occurred in Hamburg, Tokyo and Hiroshima need not happen here. When air raid fires start they are no different from the hundreds of thousands of peacetime fires which start in this country every year, and which are extinguished individually before they do widespread damage. The methods for putting out such fires are virtually the same in war or peace.

Small fires can be stopped by trained amateurs. Some large area fires cannot be stopped even by professional fire-fighters using the most modern equipment. Consequently, every little blaze throughout the bombed area must be extinguished as soon as it starts. This means that plant management must assume direct responsibility for organizing and training a plant fire defense organization which is capable of putting out any blaze that may start on its property before it extends to neighboring structures.

Fire defense measures developed to counteract the fire affects of A-blast should also serve to reduce the danger of other industrial fires, both those starting from natural causes, and those which might be started as the result of enemy sabotage.

Plant Fire Chief

Every plant should appoint a Plant Fire Chief. In small plants this will be a part-time job. In medium and large-sized plants it should be a full-time job. In times of emergency, and with respect to all defense matters, the Plant Fire Chief is responsible directly to the Plant Defense Co-Ordinator. In some plants it might be desirable to place the plant fire department permanently under the Defense Co-ordinator.

Duties of the Plant Chief include: (1) acquiring technical knowledge of industrial fire defense sufficient to meet the needs of his plant, by reading recommended literature, consulting with local fire authorities, and possibly attending industrial fire defense schools; (2) drawing up an inventory of plant fire hazards based on the vulnerability survey reports and on his own personal inspection; (3) preparing a fire defense plan covering organization, supplies and equipment, training and operating procedures; (4) submitting this plan to the defense planning committee; (5) on approval, putting the plan into effect. The Plant Fire Chief should review the plan with the municipal fire department and if necessary secure advice of special fire defense consultants.

Other responsibilities of the Plant Fire Chief include developing fire safety requirements; supervising inspections; holding drills; personally inspecting extinguishers, hoses, buckets and other fire-fighting equipment, inspecting exit doors and panic bars. He should confer with the Chief of Engineering Services to make sure that adequate water will be available for fire-fighting purposes. If dangerous fire conditions exist, he should see that they are remedied.

One of the most important functions of a Plant Fire Chief is to see that an effective training program is carried out. This training may be performed by him personally, or co-operatively with the regular civil defense training staff reporting to the Plant Defense Co-ordinator, or by making arrangements for plant fire defense personnel to attend training courses provided by the municipal civil defense organization.

Organization of Fire Service

The size of the fire department will depend on how large the plant is, the hazards to which it is exposed, and the availability of municipal fire departments.

Plant Fire Brigade. This is the mobile force which responds to all alarms within a plant in a manner similar to that of an organized municipal fire department. It should be composed of trained men who are fully familiar with plant fire-fighting equipment. The fire brigade can include a number of fire companies, each consisting of enough men to get two hose streams into action.

Fire Squads. These are regular company employees who perform duties somewhat similar to those of volunteer fire-fighters when a fire is discovered. They are selected among occupants of different floors and areas throughout the plant and are responsible to the Plant Fire Chief.

Their duties include: (1) making periodic inspections of their assigned areas to discover fire hazards and violations of fire prevention rules; (2) in case of fire, sounding the alarm; (3) taking immediate measures to extinguish fires or prevent their spread; (4) assisting the regular fire brigade under direction of the Plant Fire Chief.

Fire Defense Measures

The steps which can be taken to reduce fire hazard in industrial plants are numerous, varied, and complicated. One of the most important texts on the subject of fire defense extends to over 1500 pages. [8-5]

Selection of the measures to be used in any particular plant is the responsibility of persons trained in fire defense. A few countermeasures in connection with industrial fire defense are listed below for purposes of illustration.

Keeping fires from starting by

- removing light combustibles from direct exposure to thermal radiation
- making sure that roofs are fire resistant
- restricting use of flammable materials inside of buildings
- prohibiting storage of flammable liquids in containers which could be overturned by A-blast
- avoiding accumulation of combustible waste and rubbish
- keeping open spaces between buildings clear of flammable materials

Installing equipment and procedures for prompt detection and reporting of fires.

Restricting spread of fires by

- installing fire walls and shutters
- using fire resistant construction
- installing automatic fire doors to bar the passage of fire from one room to another
- fireproofing combustible surfaces with fire retardant point.

Extinguishing fires promptly by

- establishing definite fire routines to be followed by all personnel when fire is discovered
- securing proper fire-fighting equipment
- providing a plentiful source of water for fire-fighting purposes
- training all employees to cooperate in extinguishing fires.

Fire Equipment

Fire underwriters and public fire departments will advise regarding the amount and kind of fire equipment needed for a particular industrial installation, including portable fire extinguishers, hand pumps, hose, ladders, buckets of sand and miscellaneous fire-fighting tools.

Water is by far the most important fire-extinguishing substance. It is quite probable that no water will be available from the municipal water system at many points after an attack; accordingly there should be enough water stored at or near the plant site to keep all fire hose streams going for at least one hour. British and German industrialists all agreed that there never could be too much water available to fight factory fires.

Rescue

The A-blast knocks down thousands of buildings at a single blow. In these buildings and in shelters there may be tens of thousands of persons: some injured, some unharmed, some dead. It is the job of the Rescue Service to extricate as many of these trapped persons as possible.

Basic rescue steps are as follows: (1) to ascertain by shouting and other means where living persons are trapped; (2) to reach the trapped persons by tunneling through debris or removing the rubble layer by layer; (3) to give temporary first aid against shock, bleeding, suffocation, asphyxiation, and broken limbs; (4) to remove living casualties to the street or open space, and turn them over to the medical service; (5) to make a very thorough search of entire factory area to find bodies blown some distance by the blast; (6) to remove bodies of persons killed, where this is possible without danger to rescue teams.

Rescue work is dangerous, technical and exhausting. The Rescue Chief should be a good strategist, robust capable of understanding complicated rescue methods, and above all, he should have the ability to inspire his men with a spirit of teamwork.

The desirable size of a rescue team is eight men, including a leader, a deputy leader, and a driver. To provide for round-the-clock operation, it will be necessary to have two additional teams. The three teams, forming a rescue squad of 24 men can, of course, use the same set of equipment.

The exact number of teams required in any given plant can be ascertained only after a detailed study of the problem. At the initial planning and organizational stage, one team should be provided for each 1,000 employees.

The rescue teams should include riggers, building wreckers, carpenters, steel and iron workers, general construction foremen, and others familiar with building construction.

Rescue techniques cannot be improvised, or learned from a textbook. Formal training is the only effective method. The State of New York has such a Rescue Training School now giving courses to Civil Defense Rescue Chiefs. The Federal Civil Defense Administration also trains state and municipal civil defense personnel in rescue methods at its schools. These, in turn, will provide local training for members of civil defense groups in each area, including rescue teams of industrial plants.

Clearance, Demolition and Repair

One of the wisest moves an executive can make to insure that his plant gets back into full production after an A-bomb attack is to see that adequate clearance and repair plans are prepared *in advance.* Repairs which might be simple routine under peacetime conditions become very difficult or even impossible after an A-bomb attack because of lack of necessary replacement parts or of the written specifications and blueprints which show design of the machine or structure as originally built.

Functions of Clearance, Demolition and Repair crews after a raid include the following:

(1) assist rescue crews in removing casualties;
(2) remove fallen wires and other immediate hazards from plant area, block off dangerous areas;
(3) demolish unsafe structure: walls, roofs, stairways, floors, overhanging masonry;
(4) clear debris away from machinery and equipment to assess damage and plan repairs;
(5) make emergency repairs to utilities: power, water, sanitary systems;
(6) make emergency repairs to production equipment to permit earliest possible resumption of production;
(7) remove all debris and rubble to salvage dump on plant site for sorting and possible future use.

Clearance, Demolition and Repair crews should be

made up of carpenters, machinists, tinsmiths, pipefitters and other construction type personnel. These skilled workers can in turn be assisted by laborers recruited from the plant's regular production force.

CDR crews work with all types of construction machinery and with such simple tools as crow bars, pick-axes, shovels and wheelbarrows.

There will be a heavy demand for machinery such as bulldozers, earth mover, and the like, and you may not be able to purchase or rent such equipment after an attack. In Britain many companies gained satisfactory results by developing "repair pools" with competitors in the same line. Expensive repair equipment was kept at centrally located points to be drawn upon as needed by members of the pool. Also, stocks of replacement parts needed for anticipated repairs should be carefully selected and stored in places which are safe, convenient and accessible.

Utilities

A survey should be made of the probability of interruption of utility and related services in order to determine the most effective but economic countermeasures.

The basic measures for protecting the plant against loss of utility and related services are:

use of substitutes: for example, battery-powered lamps for electric lights;

standby service: e.g., a plant-owned diesel generator for emergency power service;

dispersal: e.g., placing step-down transformers at opposite ends of plant area;

shielding and protective construction: e.g., installation of concrete baffle walls around steam boilers;

repair: making advance preparations for rapid repair of damaged equipment.

Public Utilities

Local utilities officials should be consulted to learn what they have estimated to be the effect of atomic bombing on their service in your plant.

Plant Utilities

Lighting. Provision must be made for emergency lighting to be available immediately on the loss of electric power. Sudden darkness is one of the worst causes of panic and accidents in crowds. Sufficient lighting should be available to enable employees to shut off machines, execute raid routines, and find their way to shelters. Lighting must also be provided for first-aid, rescue, and fire service immediately after a raid.

Electric Power. Whether provision should be made for separate power facilities in the plant area depends on possible loss caused by interruption of power and lighting service versus cost of purchasing and maintaining standby equipment. There are many types of standard electric generating sets available for industrial use.

Frequently, mutual aid arrangements can be made with nearby plants to exchange use of emergency power facilities.

Telecommunications. Present plant communication systems should be investigated to determine their effectiveness and operability under disaster conditions. Consideration should be given to the installation and use of private telephone exchanges, public address systems, interdepartmental bell or horn signals, fire alarms and watchmen's signal stations.

Telephone switchboards should be moved to a safe place and provided with as much protection as circumstances permit, since it is important that the switchboard be operated to the maximum extent possible immediately before and even during a raid, and it will be the duty of operators to stay at their posts as long as possible.

Water. An adequate water supply is vital to industrial defense immediately before, during, and after a raid. Water is necessary for fire-fighting, health and sanitation, drinking and industrial purposes.

Frequently alternate water supply sources are available from nearby rivers, lakes or ponds, from other industrial plants or from subsurface water sources. If such sources are not available it is important to maintain on the plant site static storage of enough water for minimum fire-fighting purposes.

Enough drinking water to last the entire working force for at least two days should be kept at the plant site. A survey of plant facilities will often reveal a surprising number of water storage points.

Waste Disposal. Interruption of water service stops the operation of the usual facilities for disposing of human waste, and provision must be made for emergency facilities. This service may be provided by latrines set up on the plant site, by portable privies set over manholes in the street, or by a scavenger system involving the collection of waste in special containers such as metal cans with covers, chemical toilets, and specially treated water-resistant paper bags. Contents of the containers can be disposed of by burial in the earth, emptying into an operating portion of the sewer system, or hauling to a sewage treatment plant or incinerator.

Industrial waste is an entirely different problem and varies so widely from plant to plant that no general rules apply. Each plant should investigate its own situation to determine if some make-shift arrangement cannot be devised to make sure that accumulation of industrial waste does not hinder or stop production.

Protective Construction

Protective construction is a term which has grown up in the field of civil defense planning to describe the measures which can be taken to mitigate the effects of an enemy attack on structures of all types through alteration and strengthening of existing buildings and inclusion of protective features in design of new construction.

The aim of protective construction is to minimize damage to structures and to offer partial or complete protection to occupants and contents of buildings from the blast, radiation, and fire effects of an atomic explosion.

Resistance to blast depends on the type of structure, materials used in its construction, shape, size, and other details of design.

Resistance to fire damage is approximately the same as for the hazards of peacetime fires.

Protection against thermal radiation can be furnished by almost any material except clear glass.

Nuclear radiation, however, can be stopped only by relatively large amounts of material, the degree of protection depending on the weight or density of the material used. A hundred pounds of concrete gives about the same amount of protection as a hundred pounds of lead dstributed over an equal area. The most economical materials to use are earth and concrete. A reasonable degree of protection against radiation from a nominal atomic bomb at 2500 feet from ground zero is provided by 18 inches of concrete or thirty inches of earth.

The damage probability survey referred to in Chapter VII should be studied to determine what structural changes are in order.

An A-blast which heavily jars an entire building will knock loose fixtures, equipment, and false ceilings, which fly through the air, damage equipment, and injure or kill human beings. They should be removed, or safeguards installed to prevent injury to workers and damage to equipment.

Perhaps the greatest indirect hazard to personnel is from flying glass. Most measures which are effective in protecting against this danger shut off light or have some other major disadvantage. Possibly at a later date a satisfactory plastic substitute for glass may be developed.

In protecting valuable machine-tools the main point to remember is that there is little danger of direct damage from the A-bomb blast itself, but considerable danger from falling debris and roof collapse. Protective measures should be geared to this fact. Blast walls around transformers and other equipment will be effective in reducing damage. These walls should be of reinforced concrete twelve inches thick, and resistant to overturning.

Only an experienced architect is qualified to design protective changes in existing structures. Preferably, he should also have training or experience in civil defense planning and industrial design.

Here, as elsewhere in civil defense planning, it is important to keep in mind the relationship between cost of proposed changes and value of items or services protected.

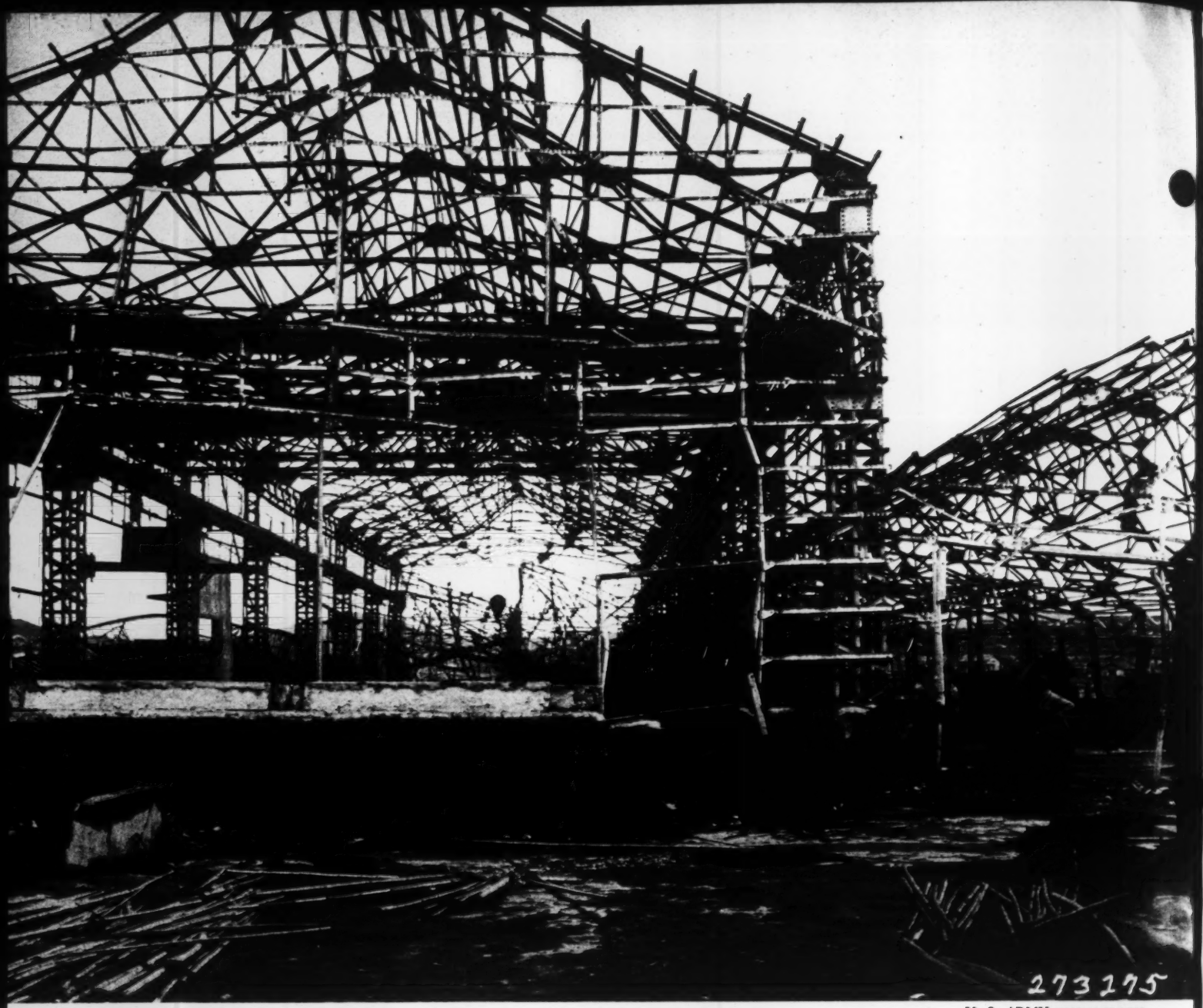
At the same time, judicious use of carefully planned structural improvements can often provide protection worth many, many times the cost. Such construction frequently will provide marked peacetime benefits: for instance, installation of well-designed ramps to replace narrow stairways will facilitate evacuation under attack conditions and at the same time may eliminate a chronic and expensive peacetime accident hazard.

Radiological Defense

In atomic warfare, radiological contamination occurs where radioactive substances from the exploded bomb are deposited, or where materials are made radioactive by the neutrons released during the explosion. The deposited decontamination may be invisible and may be carried on dust or in water vapor depending on weather conditions and on the type of detonation: water, ground, or air.

A high air burst will not contaminate materials on the ground to any significant degree.

The closer to the ground the burst, the greater the contamination of objects on the ground. A burst close to the surface of the earth, underground, or under water, could throw dangerous amounts of radioactive material over a wide area. However, the chance of blasts of these types is slight and few industrial firms



U. S. ARMY PHOTOGRAPH

Steel-framed buildings of the Mitsubishi Steel Works in Nagasaki after the atomic explosion

would be affected. Nevertheless, the probable danger is sufficiently serious to warrant careful consideration in planning an industrial defense program.

Radiation cannot be destroyed by any means known to man. However, the intensity of radiation decays naturally at a fixed rate ranging from a few seconds to thousands of years. This rate of decay is determined by a number of technical factors which need not concern us here. What we are interested in is how soon radioactivity has decayed to the point where it is no longer injurious to human beings, and this can be accurately measured by a number of instruments such as the much-publicized Geiger Counter.

Defense against the danger of radioactivity includes (1) detection of radiation; (2) decontamination or disposal of radioactive objects and (3) cure of radiation sickness. Detection and decontamination are engineering problems. Cure of radiation sickness is a medical problem.

After an A-bomb attack, the radiological monitors enter an area with their detection instruments to determine the intensity of local radiation. If the intensity of radiation is at a dangerous level, it will be necessary to mark off the area and keep human beings at a safe distance. However, the intensity of radiation will steadily decay and the area can be safely occupied by

human beings for longer and longer periods until finally the danger will be entirely past.

While radioactivity of a contaminated object will eventually decay of its own accord to a safe level, this period of waiting may be prohibitively long and accordingly it will be necessary to make efforts to decontaminate the object by positive means. Fortunately radioactivity is usually only on the surface or close to the surface of an object.

Radiological decontamination is defined as the reduction or removal of the health hazard resulting from contaminated materials. This is accomplished in three ways: (a) by removing the surface layer of the object which contains the radioactive substance, (b) by covering the object with a sealing material, (c) by removing the object to a place where it will not constitute a hazard to personnel.

Surface decontamination can be effected in a number of ways: removing the radioactive dusts lying on the surface with vacuum cleaning equipment; hosing down the surface with water under high pressure which erodes away the contaminated surface; steam cleaning which melts grease and dissolves other surface substances; dissolving and washing away the contaminated surface with detergents, gasoline, acids, caustics and other chemical agents; wearing away the surface with sandblasting or other abrasive process; and burning off the surface with an oxy-acetylene torch.

Radioactive material removed from an object is in itself dangerous, but in a more concentrated form, and accordingly must be properly disposed of.

Decontamination by sealing prevents dispersion of the contaminating material by fixing the substance to the surface before it can penetrate into the object and then simpy allowing normal radioactive decay to reduce the hazard. It also affords ample shielding for the alpha and the low energy beta radiations.

Removal and storage. Following an A-bomb attack, entire city blocks might be blasted into rubble. Industrial areas and large business districts might be contaminated beyond the point of salvage. Decontamination for such large areas would call for the removal of contaminated objects.

To reduce the volume of material to be removed and stored, it is often necessary to separate contaminated from uncontaminated materials, demolish objects, and burn contaminated combustibles in such a manner as to prevent spread of contamination—as for instance in the airborne flyash, which will contain a high concentration of the original radioactive substances.

Radioactive materials can be removed and stored

by burial in land set aside for the purpose,

by entombment in such places as abandoned or low grade mines or natural caves,

by burial at sea in large boxes at depth of 100 fathoms or more.

In determining at what point an area is considered safe radiologically, the fact that radiation hurts people, not objects, should be kept in mind. Accordingly decontamination should be carried only as far as necessary to remove the health hazard. It need not be complete.

It is unlikely that many industrial firms will be affected by problems of radiation detection and decontamination, but to be on the safe side, a member of the engineering or technical staff should be assigned to study the problem and recommend measures which seem to be appropriate for your firm.

Local civil defense authorities usually will be able to provide your firm with adequate detection service and advice on radiological decontamination. However, you may find it desirable to purchase detectors and send a member of your staff to a government school providing radiological defense training courses.

Safety Engineering

Development of a plant protection program offers a special challenge and opportunity to the plant official who is responsible for safety. In a sense atomic attack is the supreme safety problem.

The safety engineer with his exceptional experience, training, and technical knowledge can be very useful in at least three ways: (1) in searching out and identifying the hazards to personnel from atomic blast and fire; (2) in devising protection measures; (3) in training employees in various aspects of plant protection.

The safety engineer should be consulted continually to be sure that there are no needless accidents arising from the defense program itself, which by its very nature is designed to *reduce* danger to personnel. New hazards arise from almost every activity of the defense program: mass evacuation of buildings, sudden shutting off of power, carelessness arising from excitement, handling of unaccustomed tools—such as fire-axes and ladders—and failure of safety devices to function under emergency conditions.

At the same time normal accident prevention work should be maintained at the usual level of effectiveness, since a casualty arising from any relaxation of vigilance due to preoccupation with the plant defense program can cost just as much as a similar casualty resulting from enemy action.

Protective Concealment

Modern bombers locate their targets by direct vision or with the aid of radar. Direct vision is still considerably more accurate than radar vision in finding ground targets. Accordingly, consideration must be given to the possible use of protective concealment in civil defense.

Protective concealment includes all the means used to make it difficult for aerial attackers to find their ground targets.

To protect against daytime discovery various *camouflage* methods are employed including use of disruptive and toned-down painting; planting of disruptive shrubbery; use of camouflage nets, garnishing materials, and smoke screens; altering appearance of a plant, and constructing a dummy replica at some distance from the real installation.

Protective concealment at night time includes *blackout* and *dimout*, which is defined as the screening, reducing or extinguishing of illumination in order to deprive the enemy of possible reference points which might aid in making attacks.

Dim-out is used along coastal areas to eliminate the reflection of community lights against the night sky, called "sky glow", which is an aid to bombardment of civilian installations on shore by enemy naval forces, and which causes merchant vessels to stand out as such clearcut silhouettes that they become excellent torpedo targets for enemy submarines.

Complete blackout has such an adverse affect on civilian life and industrial production that it will be resorted to only under conditions of extreme necessity.

There are not now any existing regulations requiring protective concealment at industrial installations. Until regulations are announced by military authorities, industrial management need not give the matter further attention, except to realize that at some future time such requirements may be put into effect.

CHAPTER XI

PERSONNEL AND MANPOWER

HUMAN BEINGS are terribly vulnerable to damage and destruction by atomic explosions, and it is quite possible that most of the employees of your company could be incapacitated in an atomic attack, forcing your firm to shut down even though structures and equipment of the plant itself were entirely undamaged. Furthermore, community life itself could be so disorganized by atomic attack and the daily livng pattern of employees so disrupted that they would be unable to report to work even though personally unharmed.

It is the responsibility of the corporate personnel department to anticipate such eventualities, to develop concrete measures for meeting them, and to embody these measures in a written report which will become part of the over-all corporate survival plan.

Personnel Records

At the heart of all good personnel management is an effective, comprehensive personnel records system. Such records are of particular importance in atomic defense.

An inventory of jobs should be made and the relative importance of all functions under emergency conditions be determined. Which jobs could be dispensed with if absolutely necessary? Where could the work be doubled up? While every job in your company may be important, in an emergency some can be postponed; some delegated elsewhere; others will remain vital. Your problem is to pick and choose wisely.

Each employee file should contain at least the following information: jobs held with your company, with other organizations, and in military service; nature of work and length of time, and job title for each position; special occupational knowledge, skills and experience not elsewhere shown in the job record; education; special training and hobbies.

Casualty identification record cards on each employee should be prepared showing the following information: (1) name, occupation, social security number, telephone number, home address, persons to be notified in case of accident; (2) usual work station; (3) color of skin, hair and eyes; sex; age; height; weight; identifying marks; moles, tattoos, scars, fingerprints and X-rays, shoe sizes, dental work, blood type. Also on card provide space for casualty number, where body was found, and parts missings.

After an attack, fresh identification cards will be filled out for all casualties not readily identified. Matching such cards with employee record cards will facilitate identification and disposition of casualties.

A summary copy of your individual employee records and of all job descriptions should be kept in a safe, remote place where it is most likely to survive attack and yet be available for immediate use following an atomic raid.

Recruitment and Replacement

The personnel department should prepare and submit to the Defense Coordinator lists of employees especially qualified to perform industrial defense work.

The number of persons to be recruited for the emergency services will depend on the total number of employees, the exposure of the area to attack, the degree of risk arising from the type of commodities being made or stored, the size, nature and layout of the buildings and plants, and the availability of help from nearby plants and the local C D organization.

Industrial defense must be ready to function on a 24 hour basis since attack may come at any time of the day or night.

Initially as a rule-of-thumb it should be planned to use 10% of the total working force on atomic defense assignments. Working experience will probably show that this figure must be upped to 25% or even more.

A recruitment and replacement plan should also be prepared which will facilitate the rebuilding of the personnel force following an atomic attack. Some steps can be taken immediately. Other measures will go into effect after a raid.

Good business management, as well as good defense planning, requires that you have at least two replacements for each position, especially for the higher-ranking jobs. Each man should be able to fill three jobs: the one he had, the one he has, and the one he would like to have.

After a raid, a quick inventory of the situation, according to a pre-established procedure, will show which jobs must be filled.

Reference to the employee summary record will provide names of personnel who can be reassigned to fill vacant positions.

When no one is available from within the company to fill a vacated job, the following sources should be explored.

retired workers
friends and relatives of employees
former employees who left because of marriage
public employment service
private employment agency
students attending school
persons older than the usual hiring limits
crippled persons
employees of bombed-out plants which cannot resume operations.

An emergency training plan should be drawn up which will make "producers" out of new workers rapidly under emergency conditions. Jobs can be simplified, written instructions prepared, and a "buddy system" established whereby each new worker will be assigned to a more experienced employee for fast, on-the-job training.

Industrial Relations

It is imperative that management representatives and employee groups establish close and effective working relationships in support of the company defense program. The first step on the part of management is to invite employee representatives to become members of the Defense Advisory Committee.

A patriotic desire to support the war effort should form the basis for resolving the inevitable differences between management and labor. Nevertheless, many new problems will arise for which no easy solution is possible. Inquiry, analysis, friendly discussions, and negotiation are the established ways of composing such differences.

One problem which has already come up in some plants is over the question of whether employees shall be paid for time spent in training for atomic defense. There is no flat answer at the present time. It must be worked out on its merits at each plant.

Other problems will arise from interpretation and application of the various provisions of existing union contracts. Many contracts require "call-in pay" if an employee reports to work and he is not given any paid work time. Others require that certain jobs always be performed by specific crafts, or that supervisors refrain from doing any production work. Some contracts provide for minimum work or pay guarantees. However, there are usually exceptions in union contracts for emergencies beyond the employer's control.

Check your contracts to make sure that you have adequate escape clauses which will enable you to operate with what help you have available in the event of an A-bomb attack. As we mentioned, the chances are that you can work out some arrangement with the unions that will cover bombing. But to be on the safe side, get any necessary clauses into your contract at the first opportunity. It might even be wise to take the extra precaution of adding a "war clause" in addition to any listing of "circumstances beyond the company's control." [4-8]

Emergency Welfare

In many bombed German and Japanese cities, large numbers of the working population took themselves off to other parts of the country because their homes were destroyed and they were without shelter, food, or money. This of course had an adverse effect on industrial production. In this country, plans are being worked out by local civil defense officials to establish an emergency welfare service to take care of basic human needs temporarily until normal conditions can be restored.

Strictly speaking, welfare is not a problem for industrial management. However, some plants may find it desirable to provide a few emergency welfare services for their own employees, at least until the community emergency welfare services can carry the full load.

Both British and German firms emphasized the importance of providing welfare services as quickly as possible after an air raid. This means that long before attack comes each company should set up policy and procedures to meet the problem promptly when it does come.

First of all a "plant emergency information service" should be provided where employees can bring personal problems which prevent them from returning to work after a raid. If employees instinctively know they can go back to their place of employment for help, part of their initial psychological distress is relieved and they feel a certain brotherliness with both employer and fellow worker which can set the stage for complete rehabilitation.

The plant emergency information service can act as a message center where all employees and members of their families can get information shortly after an atomic explosion on what has happened to their homes and their loved ones. With all normal communication facilities cut off, transportation services suspended, and thoroughfares limited to use of authorized emergency vehicles, a messenger service can be set up to carry reports to each employee's home and bring back a brief statement of what has happened to his family.

Feeding employees and their families on an emergency basis should not be too difficult. Food in hotel

size cans in balanced diet ratio can be stored on the premises. Very simple cooking and service facilities will suffice for short periods. The headaches traditionally associated with operating industrial cafeterias need not be expected here.

Some plants with ample floor space may be able to provide emergency housing facilities for bombed-out employees and their families. It is surprising how many persons could be bedded down around an industrial plant. Air raid shelter space is sometimes well-suited for temporary living. Service lanes between stockpiles in a warehouse can hold a considerable number. And in warm weather, even outdoor living on the plant site may be feasible.

It should be possible to pay employees their current salaries immediately after an attack if fiscal arrangements suggested in Chapter VIII can be realized. It may be possible and desirable to pay advances against salary, or even to lend money on a limited basis.

It may be desirable to rearrange the shift hours for employees whose homes or families have suffered bomb damage to permit them daylight hours for taking care of the innumerable personal problems which they must solve.

It may be necessary for the plant to provide emergency transportation between home and factory after an attack until public transportation services are again functioning.

It is important for reasons of morale to get employees back to work as soon as possible after their personal problems are under control. If the plant has been damaged, employees can be used on cleanup, salvage and repair work. If plant is undamaged but inoperative for other reasons crews of employees under their regular foremen can perhaps be lent to other plants in the vicinity with the understanding that they will be released back to their home plant when it can resume operations. If industry has been paralyzed generally, the local authorities will no doubt welcome all the labor crews available, particularly when they include their own trained leadership.

In any event, if a plant will take the lead in getting its employees back to work on some basis, however makeshift, it stands that much more of a chance of retaining its trained labor force during the war years when skilled and loyal help is at such a premium.

There are a number of other welfare services which will suggest themselves to management if they examine the potential needs of their employees and the resources which the company has available. Such measures may not only be valuable in helping to get the plant back into production as quickly as possible, but may pay rich returns in employee loyalty and good will over subsequent years, and in the last analysis are amply justified for purely humanitarian reasons aside from any other consideration.

CHAPTER XII

EMERGENCY MEDICAL SERVICE

AFTER A COMMUNITY has suffered an A-bomb attack, the peacetime practice of calling doctors to the aid of the injured is out of the question. Rather, casualties will have to be brought to regular hospitals and to improvised emergency hospitals, where medical treatment will be given on a mass production basis, which has as its fundamental strategy the maximum saving of life, limb and bodily function within the limits of the facilities, personnel and time available. [12-5]

Under this strategic plan, it is essential that a highly efficient first aid and casualty transportation service be organized. It is imperative that each casualty be given at least elementary first aid as fast as possible on the spot after an A-blast in order to keep him alive until he can be given full medical attention. Thousands of lives can be saved by such simple first-aid measures as stopping of bleeding from open wounds, applying artificial respiration, and counteracting the effects of shock.

Trauma and burns from atomic explosions are the same as injuries experienced in peacetime industrial accidents and are treated in the same way.

For the most part, treatment of radiation illness does not begin for 24 hours or more, and accordingly does not constitute a problem to be dealt with by a plant medical service.

Organization

The community emergency medical service functions as a single organization on an area-wide basis and includes in its jurisdiction and control all medical personnel, installations, eqiupment and supplies in the area, whether privately or publicly owned. Under this concept the plant medical service must be regarded as part of the community emergency medical service and be prepared to give or receive help accordingly.

The main function of the emergency medical service at a plant which has sustained a large number of employee casualties will be to administer emergency first aid to keep victims alive until they can be transported to an emergency hospital established to provide more advanced treatment.

Plant Medical Director. A Plant Medical Director should be appointed in plants which do not already have such a position. In small plants it would be a part-time job. In larger plants it would be a full-time job, especially where the company already has a full-time medical doctor responsible for the plant medical service. In peacetime the Plant Medical Director would be responsible for the usual plant health and medical problems. At times of attack he would function as part of the staff of the Plant Defense Co-ordinator. Generally speaking, the Plant Medical Director should be a physician. However, where the Plant Medical Director is not himself a medical doctor, he must of course secure consultation and advice from qualified physicians, preferably with training in public health or in industrial medicine.

The civil defense responsibilities of the Plant Medical Director include: (1) developing an understanding of the medical problems of industrial defense by studying available texts and attending local training courses; (2) preparing an estimate of probable number and nature of casualties at his plant; (3) developing basic working plans for the medical service; (4) organizing medical service, including securing services of professional personnel such as doctors and nurses and recruiting of emergency workers from plant employees and supervisors; (5) preparing schedules of supplies and equipment required; (6) training or arranging for training of members of Plant Medical Service; (7) providing advice to other plant defense services on health and medical problems; and (8) co-ordinating his plans with those of local municipal officials, medical authorities and medical directors of nearby plants and institutions.

Medical Doctors. Full-time industrial physicians on the permanent staff of large industrial plants can of course take over the duties of the Plant Medical Director. Smaller plants may be able to make arrangements with part-time contract physicians or industrial clinics to provide technical advice and assistance in developing the plant medical service, and even to take charge of the medical service under emergency conditions. Such assignments should be cleared with the head of the local civil defense medical service.

Nurses. Many plants have full-time nurses who can provide invaluable assistance in developing the plant medical service and in training personnel. Smaller

plants may be able to obtain part-time services of retired or inactive trained nurses living in the vicinity.

Nurses' Aides and First Aid Workers. To supplement the inevitable shortage of physicians and trained nurses, qualified personnel should be recruited and trained as nurses' aides and first aid workers. The American Nation Red Cross has established training courses for such personnel.

First Aid Teams. First aid teams should be established to provide a minimum of emergency medical aid to injured persons until they can receive the attention of a physician, to assist doctors and nurses, and to supervise movement of casualties by stretcher teams.

Stretcher Teams. A stretcher team consists of four persons trained in loading and unloading stretchers, in taking patients in and out of ambulances, and in emergency action to preserve life in living casualties. Initial operating plans should provide one stretcher team for every 100 employees.

Plant Medical Installations

Clearing Stations. Larger plants with their own hospitals or dispensaries and full-time physicians should plan to use these as clearing stations in event of attack.

Functions of such clearing stations include (a) receiving casualties from one or more primary medical aid posts established on the plant site after attack; (b) supportive treatment of stretcher cases—blood plasma, morphine, temporary surgery; (c) treatment of ambulatory wounded; (d) classification of wounded for transport to emergency or remote hospitals, or for discharge; (e) preparing medical records.

Primary Medical Aid Posts. These posts are set up after attack in the most suitable structures remaining in useable condition and as close to the center of destruction as it is feasible to approach by vehicle. It will be more practical to plan for establishing several small primary medical aid posts than a single large one, because the distance stretcher bearers must carry the injured will determine the rate of work in the posts.

The functions of a primary medical aid post include: (1) screening casualties as they are brought in to determine priority of attention; (2) controlling hemorrhage; (3) treating shock; (4) relieving pain; (5) dressing wounds; (6) giving blood or blood substitutes; (7) applying or adjusting splints; (8) giving antibiotics if transportation onward is unduly delayed; (9) initiating casualty records; (10) releasing patients from further medical treatment or arranging for transportation to clearing stations or emergency hospital.

Also, standard industrial first aid cabinets stocked with first aid supplies, stretchers, splints, bandages, and blankets, should be placed at readily accessible locations throughout the plant.

Supplies and Equipment

Procurement, storage, control and distribution of medical supplies and equipment offers a major strategic problem. The vast quantities of materials required for the victims of a single atomic bomb will be beyond the resources of any community to procure. It has been estimated that a stock of even the most elementary life-saving surgical supplies would fill 100 railroad box cars or 175 large trailer vans. In fact, adequate quantities of many items do not exist, but must be produced according to specifications.

Civil defense authorities have urged that procurement of civil defense medical supplies by industrial plants be limited to those items designated in standard lists, but be in sufficient quantities to represent a significant contribution to the community civil defense reserve supplies. Small amounts distributed widely over a target city cannot be assembled quickly enough to be of value in the event of attack.

Plant managers in target areas have been asked to stock sufficient approved supplies to provide treatment for 40% of the total number of persons likely to be present in their plants at any one time.

One such standard list of supplies designed to take care of 600 casualties in the first 24 hours of operation was estimated to cost $3,000 and included 78 different items such as the following: stretchers, surgical sissors, forceps, breathing tubes, sedatives, surgical sponges, gauze, dressings, bandages, hypodermic needles, suture needles, tourniquets, blankets, basins, towels, work tables, gasoline lanterns, and sterilizers. [12-5]

Ambulances. Many plants now have their own ambulances or have contracted for ambulance service. In either case the number of ambulances actually available would be inadequate for more than a small number of casualties. Plans should be made to supplement these services with converted truck ambulances.

Each primary medical aid post would require a minimum of two ambulances or truck-ambulances, each capable of carrying four stretchers plus four passenger vehicles available for transporting ambulatory cases.

Medical Liaison

Throughout this *Report* we have reiterated the importance of co-operation between plant defense officials and local authorities. This is of particular importance with respect to medical defense. There are simply not enough supplies, facilities and personnel in any area to take care of all the expected casualties. Nor would it be possible to assemble a full reserve at every point of expected attack. Also, many of the medical facilities and much of the equipment normally in an area will be destroyed by the attack itself.

The only possible answer is to plan in advance on a

community-wide basis for transporting medical help from unbombed areas into the affected area as fast as possible. This planning must take place on national, state, regional and local levels. Industrial plants must participate in such planning on the local level. Not even the largest industrial facility with the most highly developed plant medical service could take care of the huge number of casualties which might result among its own employees from an A-bomb attack.

Such planning for mutual aid must include sharing facilities, developing standard lists and stockpiles of medical supplies, exchanging trained personnel, standardizing procedures, and participating in area-wide training and test exercises.

CHAPTER XIII

WARDENS, POLICE, AND INTERNAL SECURITY

IN SOME PLANTS the Wardens' Service and Police Service will be combined but the internal security program will be handled separately. In other plants, the warden's service will operate independently but the police functions and the internal security functions will operate as part of the same service. Whether these three activities are handled through one organization or separately depends on local circumstances. But, in any case each service is essential and in this *Report* we shall discuss each of them as a distinct unit.

Warden Service

During the period before an emergency the warden's major duty is that of teaching; during an emergency, that of conducting people to safety; after the emergency, that of restoring order.

Period Before Emergency. The warden acts as the morale officer and civil defense teacher of the organization. He or she should get to know every member of the group for which he is responsible and see to it that they all know the safety measures to be taken by individuals at the time of attack, so that in an emergency each person knows where to go, how to get there, and what to do.

In many industrial plants, it will be desirable to assign the warden duties to foremen or supervisors. They are accustomed to exercising leadership among their employees, and are more familiar with the plant, its organization, layout, and manufacturing processes.

Attack Without Warning. If an atomic bomb explodes in a plant's vicinity without warning, the warden will try to protect himself immediately, according to the rules for personal survival. If employees under his direction have been properly instructed, they will spontaneously execute the procedure for survival under conditions of unannounced attack. After the immediate effects of the attack are over, the warden will check up on the location and condition of his group, giving first aid where possible to the injured, and sending a report to the plant control center.

When Air Raid Alarm Sounds. When warning of imminent attack is sounded, the warden supervises the movement of the personnel for whom he is responsible from their work stations to assigned shelter without confusion, noise or loss of time. He should make sure that every person in his group is present or accounted for. In the shelter, the warden is responsible for those under his jurisdiction, administering first aid, maintaining order, and quieting the frightened.

After Attack. When danger is past the warden will give emergency help to those suffering from shock, hemorrhage, burns, or other injuries, check on the condition and whereabouts of all persons in his group, and make a report to the control center.

As soon as the immediate needs of his group are taken care of, he should assist them in personal problems, such as recovering personal property, getting additional medical attention, securing transportation home, and the like.

After that the warden should assist, and get employees in his group to assist in the work of the emergency services, especially fire, rescue, and first aid.

Plant Chief Warden. A Chief Warden and a Deputy Chief should be appointed to organize the Warden Service and train its members. The key qualification of the Chief Warden is capacity for personal leadership. He should analyze the problem of individual employee safety under attack conditions throughout the plant, and develop corresponding safety measures. On the basis of this plan he should determine the number of wardens required, which would usually run from 8 to 20 for every 1,000 workers. For each 10 wardens he should appoint a senior warden who will supervise and train a given number of wardens.

Police Service

The plant Police Service is responsible for maintaining order and discipline, for safeguarding people and property, for directing traffic and for supporting other services in carrying out their duties.

When disaster strikes, the initial problem facing police is traffic and crowd control. In a large organiza-

tion the volume of traffic under normal conditions may be sufficient to create a problem. In an emergency, traffic can get entirely out of hand, resulting in panic and a breakdown of other protective operations. Entrances, traffic lanes and roads must remain clear for free passage of fire equipment, ambulances, rescue trucks and other emergency vehicles.

The general excitement and disruption of normal activities produced by an enemy attack provides an unusual opportunity for looting. Even normally law-abiding citizens often can't resist the temptation to carry off valuable property exposed by disaster damage. And of course it is a golden opportunity for the foreign espionage agent. The police service must safeguard vital records, specifications and material and protect instruments and machinery. It should arrange for guarding entrances, for patrolling all areas inside and outside of buildings at the plant's site, for holding and reporting suspicious persons and for preventing looting.

Plant Police Chief

The Plant Police Chief should have definite executive or supervisory ability, and if possible, training or experience in public safety.

His first job is to analyze the police requirements of his plant and to prepare for review by the Defense Advisory Committee a complete description of these requirements with specific recommendations for the establishment of an effective police service.

His next job is to organize and train a Police Service including guards, patrolmen and traffic police.

Organization

In general, plant police services should be set up on the basis of one officer for every fifty occupants or employees. If you already have a guard or detective service, it should be trained to meet emergency responsibilities and be expanded if necessary.

The Police Service may range in size from a guard and night watchman in a small plant to an organic police force in a large plant organized in squads under the command of a corporal or sergeant who, in turn, is responsible to a lieutenant or captain. In a big plant, each squad should be assigned specific duties, such as the control of traffic, safeguarding of precision tools, etc.

The Police Service should be mobile and ready to support the other protective services. Usually, police are not stationed at one point but are deployed throughout the plant or move on patrol work from point to point.

All members of the Police Service should be thoroughly familiar with the layout of the plant, including the location of first-aid stations, power switches, and with traffic lanes leading to and from the plant buildings and to the plant area from the surrounding territory. They should understand the operation of the municipal fire alarm system and know the location of the police precinct serving the plant area.

Guards

Guards should be of good physique, and high moral character, and should be investigated even more thoroughly than other employees before being hired. If possible, they should be deputized, uniformed and, in some cases, armed. They must be well schooled in the use of their weapons and in offensive and defensive tactics. However, tactics must be combined with tact. They must know how to get the co-operation of employees and of the public in observing security regulations without causing unnecessary irritation. Previous military, industrial, or municipal police or investigative experience is desirable. Guards should be instructed to make friends cautiously among the employees, if at all. It would be desirable if they could keep their social life apart from that of plant personnel.

Police Liaison

The plant police chief should review his plans with local law-enforcement authorities to be sure that they will function effectively in co-ordination with local civil defense plans under attack conditions, and that his proposed measures do not violate any local laws, rules or regulations, particularly with respect to the carrying of firearms by plant patrolmen, whether on or off duty.

Also joint traffic procedures should be cleared with the local police department and civil defense officials to avoid conflict of plans in an emergency. It is well to have two traffic plans—one to be used when the plant only is affected, an another to go into operation when neighboring plants or whole communities are involved.

Internal Security

Counteraction against espionage and sabotage is primarily the responsibility of government agencies specifically assigned this mission. At the same time, there are a number of steps which industry can take to assist these government agencies and reduce the danger from these subtle enemy weapons.

If you have an important government contract involving the manufacture of secret or confidential items,

you will receive detailed instructions on preventive measures from government representatives. However, even if you do not have such a contract, you should acquire general familiarity with the elements of the problem of internal security, and install a few of the simpler protective measures.

We shall describe here certain elementary considerations and security measures for the use of plant management. More detailed information can be obtained from publications listed in the Bibliography. [14-1, 14-2, 14-5, 14-6, 14-7, 14-8, 14-9]

Espionage

In this country we are peculiarly vulnerable to espionage because (1) our industrial technology in warfare is so far ahead of other nations that it is to their advantage to make heavy investments in espionage in an effort to catch up with our industrial advances; (2) we are not especially "spy-conscious," and therefore are less on guard against this particular form of attack. The most important secrets of the A-bomb were transmitted to the Soviet through co-operative efforts between Russian agents and American and British research workers. This happened despite the best efforts of our security organizations to prevent just such a calamity. This points up the necessity of being even more careful as time goes on.

Responsibility for Classified Information. Management must answer for the security of classified information which may come into its possession as a result of contracts with the military services. Security regulations furnished by the contracting authorities must of course be complied with in full. The Department of Defense will offer advice concerning methods of safeguarding information and the Federal Bureau of Investigation will investigate cases of suspected espionage.

Information Sought. In general, enemy agents want information from within industry which will lead to an evaluation of our war potential and an understanding of technical improvement in war weapons and information which can be used to advantage in planning sabotage and open military attack.

The specific information usually sought from industrial plants includes (1) capacity and rate of production, industrial mobilization schedule, and details of orders on hand; (2) plans and specifications of munitions produced; (3) test records of newly developed items of equipment; (4) sources of raw materials and components; (5) destination of complete units and transportations routes; (6) data on production methods; (7) critical points and possible methods of effective sabotage; (8) measures in force for security and to prevent sabotage, such as frequency of inspections by guards and their dependability; (9) dissatisfaction among labor elements which might be employed in subversive activities.

Methods. Espionage agents may be expected to use great ingenuity in obtaining information. They will try: (1) to infiltrate into plants as employees, visitors, or inspectors; (2) to obtain information from employees by theft or purchase, or by encouraging "shop talk"; (3) to steal information from records, reports and studies on production operations, test runs, and specifications for classified materials; (4) to use various means for reproducing documents, products, processes, equipment or working models; (5) to use "fronts" such as commercial concerns, travel agencies, import-export associations, scientific organizations, insurance agencies, businessmen's groups and other organizations to obtain confidential information or pertinent statistical data which can be translated into strategic information; (6) to use threats of blackmail to obtain information; (7) to pick up information in social gatherings.

Countermeasures. In general, espionage may be rendered ineffective by the following measures:

- special guarding and handling of classified information along the lines recommended in government manuals
- checking loyalty of personnel, especially before employment
- establishment of identification system for employees and visitors
- preventing unauthorized entry into premises
- restricting movement within the plant area
- training in security measures those employees who have access to critical information.
- reporting of suspected subversives to F.B.I.

Sabotage

Insofar as sabotage is concerned, the best course for management to follow at the present time, pending further announcements or instructions from the government, is to develop an understanding of sabotage dangers and defense, to plan on the installation of simpler countermeasures, and to be prepared for more stringent precautions at a later date, if necessary.

It may be a part of enemy strategy to avoid any detectable sabotage efforts until the launching of an open attack, and then put into effect a master sabotage plan covering a large number of installations. In terms of trained manpower, equipment and munitions risked, a sabotage operation involves only negligible expenditure by the enemy, but the profit may be enormous if the targets have been strategically selected.

Methods of Sabotage. Possibly the best way to find out what could be done by the enemy would be to assign to a plant official the role of a saboteur who is

out to do the greatest possible damage to your plant. Methods of sabotage may be classified as follows: (1) *mechanical*—breakage, insertion of abrasives and other foreign bodies, failure to lubricate, maintain, and repair machinery, omission of important parts from completed products; (2) *chemical*—insertion or addition of destructive, damaging or polluting chemicals into supplies, raw materials, equipment, product or utility system, or introduction into ventilating systems of large plants one of the deadly nerve gases which are odorless, tasteless, invisible and quite lethal even in very small amounts; (3) *explosive*—damage or destruction by explosives, or the detonation of explosive raw materials or supplies; (4) *fire*—ordinary means of arson, including incendiary devices ignited by mechanical, chemical, electric or electronic means; (5) *electric and electronic*—interference with or interruption of power, jamming of communications, interference with electrical and electronic processes; (6) *psychological*— the fomentation of strikes, jurisdictional disputes, unrest, inducing excessive spoilage and inferior work, causing slow-down of operations, provoking fear or work stoppage, character assassinations, and on a larger scale, and disseminating inflamatory propaganda so as to break morale. [14-5]

Prevention of Sabotage. Countermeasures against sabotage include denial of access by the saboteur to key points within the plants, control of the would-be saboteur operating from within, and limiting damage once an act of sabotage has been done. The measures employed to prevent sabotage are quite similar to those required to prevent espionage. However, two counter-measures should be emphasized: the guard force, and use of physical protection devices.

Guard Force. No physical barrier is effective unless backed up by human observation. Fences, locks and bars will delay, but will not stop, a determined intruder. Normally, guards will be the principal means of enforcement. Stationary guards are required at unlocked entries. Roving guards must be provided to patrol other vulnerable points of possible entry. Guards and watchmen should make regular non-scheduled patrols throughout the entire plant on a 24-hour basis covering the interior and exterior of all important buildings.

Physical Protection. Maintaining a fully effective guard force is quite expensive and does not directly contribute to war production. Accordingly, use of mechanical devices and other physical measures should be considered: (1) *fencing* around plant site; (2) *special electronic devices* are available for detecting intruders; (3) *entrances* should be kept to a minimum, and locked or guarded when not in use; (4) *screening* should be used on all vulnerable windows, ventilators, drains or other small openings; suitable barriers should be erected where access might be possible from adjacent buildings, roofs, overpasses, etc.; (5) *special fences, walls, lights* and *alarms* should surround key machines and equipment, particularly those which are hard to replace and whose damaging would seriously affect production, such as switchboards, transformers, regulator stations, power terminals, and specially designed machinery.

Federal Bureau of Investigation

The President of the United States has called upon all law enforcement officers, patriotic organizations and individuals to report information pertaining to espionage, sabotage and subversive activities to the Federal Bureau of Investigation.

The FBI is as near to you as your telephone. The first page of every telephone book in the country lists the nearest office of the FBI.

Feel free to furnish all facts in your possession. Many times a small bit of information might be the clue to solving an important case.

The FBI is interested in receiving *facts* about what a person does to undermine internal security, not in what he thinks. Avoid reporting malicious gossip or idle rumors.

Do not attempt to circulate rumors or draw your own conclusions about suspected subversive activities, since to do so may inflict grave injustice on innocent persons.

Do not endeavor to make private investigations after you have reported your information to the FBI, since this work is solely for trained investigators. Hysteria, witch-hunts and vigilantes weaken internal security. We can preserve our free institutions by protecting the innocent as well as by identifying the enemy within our midst. In counterespionage work, it is more important to identify spies, their methods, and their sources of information than to make immediate arrests.

CHAPTER XIV

OFFICE OF THE DEFENSE COORDINATOR

THE OFFICE OF the Defense Coordinator will be responsible for providing the Coordinator with administrative assistance, performing certain functions closely associated with command responsibility, and developing defense activities not readily assigned to any of the emergency services or regular corporate offices.

In a typical plant, the Office of the Defense Coordinator might be responsible for the following functions and activities;

- maintaining administrative control over the development of the plant emergency services
- establishing and operating the emergency headquarters and control system for use during the disaster phase
- developing the defense training program
- conducting public information activities
- devising panic control measures
- initiating and coordinating the post-attack recovery program.

In small plants the work of the Defense Coordinator will be a part-time job and he can use regular departmental personnel on a part-time basis for necessary clerical and administrative assistance.

In medium-sized plants a part-time staff should be assigned to the office of the Defense Coordinator on a regular basis to take care of administrative work.

In large plants the Coordinator will need a permanent office, and full-time staff assistants. The size of this staff will depend on the magnitude of the plant's defense problem, and the functions which have been assigned to the Office of the Coordinator.

Consideration should be given to assigning the Coordinator certain related peacetime activities such as safety engineering, fire protection, plant police, internal security, and emergency first aid. Grouping together these essentially protective and safety functions may provide more efficient day by day service and establish a better basis for defense operations in an emergency.

Control System

Effective administrative and operating controls should be established over the plant defense program to ensure that it accomplishes its assigned objectives at all times and stays within the limits set by corporate management.

The basic control device is the Coporate Survival Plan as developed by the Defense Advisory Committee and approved by the chief executive. The Plant Defense Coordinator will in turn be responsible for checking systematically on the development and installation of the defense measures enumerated in the plan, and advising the Chief Executive on progress, and suggesting remedial measures for bottlenecks holding up completion of the corporate survival program.

The problem of establishing adequate but simple control procedures for this kind of activity is a technical specialty in itself, which normally would be assigned to the corporate executive responsible for systems and procedures planning.

During the planning and development phase of the defense program, the Plant Coordinator must work through established corporate offices. However, the "attack imminent" warning is sounded, he assumes complete operational control over all activities and is in supreme command of plant defense, responsible only to the Chief Executive.

To implement this responsibility an operational control system must be established, with four principal elements:

Control center, which serves as an operating headquaters,

Warning system, which sets the emergency defense machinery in motion,

Communications system, which transmits information between the control center and other points,

Standard operating procedures.

Control Center

The activities of the Control Center include:

- receiving air raid warnings from local civil defense headquarters;

- transmitting warnings by telephone, to individuals and by general air raid alarm to all plant personnel;
- receiving reports of damage from various parts of plant area;
- dispatching emergency units to damage points;
- reporting situation at the plant to local authorities in order that aid may be received or given under the mutual support plan;
- operating as general headquarters for relief, recovery, and rehabilitation activities after the raid until normal corporate managerial control is re-established.

In larger plants, spread over an extensive area, with many activities and numerous employees, additional control centers should be established to serve as subheadquarters and to take over the entire work of the main headquarters if it is knocked out.

The control center should be located in the safest convenient space available and provided with "maximum" protective construction features.

Personnel in the control center in addition to the Coordinator might include the Deputy Coordinator; the heads of engineering, fire warden, police, medical and welfare services; telephonists; messengers; radio operators; and clerks. The staff assistants at the control center should be alert, intelligent, self-possessed employees who are capable of working quickly, calmly and accurately under conditions of extreme tension. Their principal job will be to keep available an up-to-date record of all the damage incidents in the Plant area, the disposition of the emergency teams, and other pertinent data. Personnel facilities in the control center should be approximately the same as in the shelters.

Operating equipment should include a large scale map of the plant area, a map of the surrounding territory, blueprints of all plant buildings and structures and a copy of the survival plan.

Warning System

In establishing the plant air raid warning system, the first step is to confer with local officials to determine what warnings your plant will receive and how they will be transmitted.

The *advance* warning of *possible* enemy attack is transmitted from Air Force centers to civil defense control centers from whence it is in turn distributed by telephone and municipal radio to civil defense heads, public officials, and key installations.

When the municipal control center receives air raid warnings of *probable* enemy attack, the public alarm is sounded on sirens and other noise-making devices.

Only in exceptional cases will industrial installations be placed on the key list to receive the *advance* (confidential) warning. Normally they can expect to receive only the general public air raid alarm.

If your plant is in an area fully blanketed by the municipally operated sound devices and they provide a sufficient intensity of sound to penetrate to all work stations in your plant, it will not be necessary to provide any special equipment. However, if it is determined that the general public alarm cannot be heard at some points it will be necessary to install public warning equipment. But first check to see whether existing plant devices, such as the fire alarm or public address system, can be used to do the job.

Communications System

In order that the operational control system may perform effectively, communication services must be established which will provide contact between the control center and the following points:

nearest municipal control center
key civil defense installations
local telephone company
other nearby plant control centers
emergency operating units in plant area
other key points such as broadcast stations, etc.

Types of facilities which might provide such service include:

regular public telephone service
plant private telephone exchange
special field telephone equipment
special two-way short wave radio in portable, mobile or fixed installations
plant messenger service operated out of the control center
residuary wire services, such as stock ticker systems, teletype, central burglar alarm systems, wired music program services, and special carrier wave voice equipment over power lines
battery-operated standard broadcast radios.

Special attention should be paid to establishing an effective messenger service since it may be the only communications service working after an atomic explosion.

Messengers should be strong, persistent, alert, well-trained in message procedures, and imbued with a high sense of the importance of their work and of the dangers and responsibilities it entails.

Since roadways in the vicinity of the plant may be blocked with debris, bicycles and motor cycles which can be trundled over the debris are essential pieces of equipment.

Standard Operating Procedures

In the confusion and excitement of atomic bombing there is no time to improvise command, control, and communications methods. There must be an exact procedure for every type of repetitive activity in order that doubt and discussion be reduced to a minimum. All parts of the plant defense organization must be trained in these procedures, especially team chiefs and service chiefs. "Orders that can be misunderstood will be misunderstood," resulting in general confusion at the most critical moments. "Orders, counter-orders, disorder."

Development of such procedures is a natural assignment for the company system and procedures specialist.

Training

One of the most important single responsibilities of the Plant Defense Coordinator is the development of an effective defense training program. We have made only brief references to training in previous chapters, since the problem of training must be dealt with on an over-all basis.

If your company does not have a full-time director of industrial training, it will be necessary for the Plant Defense Coordinator to develop the training program by himself or to delegate this responsibility to some member of the company staff who is qualified to execute the functions of Defense Training Director.

"Training" is used here very broadly to include the teaching of necessary knowledges and skills to those who must take part in the industrial defense program. This means the entire working staff since every single employee has a role to play in the defense program. As a minimum, he must be trained in the rudiments of self protection.

In addition to this universal type of training, there will have to be specialized training for members of the various defense services and teams.

What to teach can be determined in the same manner as for any other type of industrial training program.

First— List operating functions which must be performed by personnel in the defense program.

Second— Group these functions into specific jobs according to standard job analysis methods. Many of these jobs have been referred to in one way or another at various points in this *Report.*

Third—Determine what skills and knowledges incumbents in each such job must have.

Fourth— Decide on best methods of imparting the necessary skills and knowledges to individual incumbent.

Fifth— Survey established trained resources available from inside the company and from outside agencies.

Sixth— Prepare a detailed statement of the training program, including listing of courses, subject headings, hours required, facilities to be used, training methods, and training schedule.

Training Methods

Selection of training methods depends on subject to be taught, persons receiving training, and time and resources available. Generally speaking in civil defense training it is better to keep class periods relatively short, and to emphasize *demonstration* and *participation,* more than *lecture* and *conference.*

Some training aids which have been found useful are planning guides, technical manuals, pamphlets, leaflets, charts, posters, films, and slides. The list of references at the end of this report provides a list of sources from which training materials can be obtained.

A number of American companies have set forth basic survival information in small booklets which are given to all employees as part of the individual training program. During World War II, many European companies issued pocket cards to their employees setting forth basic survival information such as rules for personal survival, the employee's shelter location, name of his warden and what to do after attack.

Training Agencies

In most target areas some training can be obtained through participation in training courses established by the local civil defense organization.

Some trade schools and colleges offer civil defense courses, especially in technical specialties.

A few professional societies and business associations will sponsor short-term courses in their special fields.

Industrial defense consultants and industrial training specialists can frequently provide industrial defense training programs, particularly for staff and administrative personnel.

In some areas, where industrial cooperation has reached a high degree of development, a number of firms can get together and run joint training programs. This approach will not only reduce expenses but should improve quality of training and help to standardize methods—an important consideration in working out effective mutual aid agreements.

In some communities, the local Junior Chamber of Commerce may sponsor area industrial defense training programs.

The FCDA, through its Office of Training and Education, operates schools to train instructors in civil defense techniques who may, on returning to their home organizations, pass on their knowledge and skills to others. FCDA specifically urges managements of business establishments to send trainees to these schools.

Application and requests for information should be sent directly to the Director of the Schools:

FCDA Staff College
Olney, Maryland

Western Training Center
St. Mary's College
St. Mary's, California
(Near San Francisco)

Training Stages

For planning purposes the plant defense training program can be divided into five stages.

1. **Individual Training:**—Every employee must receive general training in civil defense measures for his own protection, plus technical training if he has a specialized emergency responsibility.

2. **Team or Unit Training**—Members of defense teams such as rescue, first-aid, and fire fighting, must receive training in the fundamentals of their specialties. Team drills should be held to test how well the individuals have learned techniques and how well the team as a whole can work together.

Practice drills should be held for all the teams comprising a single technical service—medical, for instance—to develop skill and experience in larger scale operations, especially in coordination between teams doing similar work.

3. **Collective Training**—Later "practice alerts" can be held as test exercises for the entire plant protection organization, using a hypothetical attack as a basis for the exercise. At first these alerts should be announced in advance and should proceed slowly. It is better to develop proper working methods than to try to obtain speed or dramatic effectiveness in the early stages of the program. Later "surprise alerts" can be tried out. These should be kept to a minimum however because they are costly in terms of lost production.

Don't be surprised if your first "surprise alerts" seem to be complete failures—that is the universal experience of civil defense organizations. After each alert, hold critiques to discuss opportunities for improvements. Time and continued effort will eventually produce satisfying results.

4. **Combined area exercises**—Occasionally local civil defense authorities will request your plant to participate in general exercises to test the effectiveness of all civil defense units in the area. These will present valuable opportunities for checking the effectiveness of area-wide aid arrangements.

Public Information

Atomic attacks are usually directed against people—the public. The public must defend itself. Only an *informed* public can cooperate effectively in its own defense. It is the responsibility of all who originate civil defense plans, or supervise civil defense activities, to provide the public with all the information it needs to understand such plans, and cooperate in their execution.

The *publics* who are interested in your industrial defense program include:

your employees
the community
stockholders
customers
public officials.

The purpose of the Public Information Program is

(1) to condition employees to understand, accept and support the industrial defense program;
(2) to impress employees with the fact that their company is taking every precaution to protect them from the effects of A-bomb attack;
(3) to improve community relations through public support of the civil defense program;
(4) to reassure stockholders that effective steps are being taken to protect the corporation's physical assets from the effects of atomic attack;
(5) to demonstrate the company's willingness to support the national defense effort;
(6) to help avert panic during an attack and restore public morale afterwards.

The public information program should be developed in consultation with the firm director of public relations, or the person holding the nearest equivalent position. If there is no such position in the corporate set-up, it will be the direct responsibility of the Plant Defense Coordinator to work out the public information program as best he can.

Here is a check list of some specific measures which may be taken to develop effective public relations in connection with the plant defense program:

- keeping employee house organ supplied with information issue by issue
- supplying newsworthy information to local

newspapers either by press releases or by informal telephone calls; emphasizing material which can be developed into feature stories
- posting appropriate notices on bulletin boards
- keeping public information officer of the local civil defense organization advised of interesting developments at the plant
- sending summary copy of defense plan to your trade association
- assisting local civil defense program by participating in public meetings, and television and radio programs
- sponsoring public service projects in your plant: for instance, be sure your Plant participates in the local Red Cross Blood Bank program.

After an attack your public information program is particularly important. Be prepared to issue as quickly as possible an accurate and complete assessment of damage sustained by your plant. The sooner your city receives a complete and authoritative account of the damage done by an A-bomb attack, the sooner it will get down to the job of recovery and rehabilitation.

Morale - Panic

The basic strategy of defense against panic is to provide employees with information which definitely dispels the illusion that the atomic bomb is a weapon of infinite destructiveness and which conditions them to react to their natural fears in a positive and constructive manner.

Here are some specific counter measures which can be taken to reduce the danger of panic:

- include in the plant training program reliable information on the effects of atomic weapons;
- translate paralyzing *fear energy* into *action energy* by giving every employee a job to do if at all possible, even though the specific assignment may not be important and may be very simple, keep people busy;
- emphasize group activity. There is reassurance in being part of an organization larger than yourself. All employees should feel that the entire community, and in fact a good part of the nation, is involved in the same problem;
- make it clear that the civil defense program, both in the community and in the plant, is designed to get help to everyone who is injured just as rapidly as possible.
- require plant protection workers, especially wardens, to don distinctive insignia as soon as the warning sounds to indicate that the defense plan is in operation and that all measures to protect employees are being carried out.
- make frequent announcements over the public address system describing how the defense plan is working. These announcements should be as continuous as possible. Even very insignificant news items are reassuring to most people in times of stress.
- emphasize the positive. Don't say that everyone in the plant will be killed or injured if the bomb explodes without warning within one half mile. Rather say that unless there is no warning and if the bomb explodes a mile or more away at least 95% will escape death and 45% will not receive even minor injuries.
- get employees to dissipate their fears of atomic attack by discussing them freely. This may have a depressing influence in the early stages of the plant defense program, but as time goes on, and each employee realizes that his own feelings of fear and depression are shared by all his fellow workers, a community spirit will develop which will be an exceptional source of strength when the real danger does come. The emotions aroused by the attack will be no surprise to the individual worker. He will expect them, and he will know that his fellow workers are reacting in the same way, and, as a group they will respond constructively to the stimulus of the danger.
- practice going to and from shelter frequently until employees become accustomed to this group activity and to being in shelters with fellow-employees.
- precondition employees assigned to the protective teams, especially first aid and rescue, to the sight of dismembered, mutilated, bleeding, and dying bodies. During World War II the army found that this was a wise precaution in getting soldiers accustomed to the horrors of the battlefield.
- encourage employees to renew their spiritual faith. Deep-seated belief in God's Providence brings inner strength and peace of soul which will help overcome the most terrifying of temporal dangers.

Resuming Production

The supreme strategic objective of the entire plant defense program is to get back into production as soon as possible in order to help provide the vast amount of material which the armed forces will require to carry the war to the heartland of the enemy and win ultimate victory.

After atomic attack, a plant which has conscientiously completed all possible plans and preparations during the preceding years or months of grace, may now reap the benefits of such foresightedness.

It is preeminently the responsibility of top management to get the plant back into production. The Defense Advisory Committe should immediately swing into action to survey damage, prepare plans, and advise top executives on rehabilitation plans.

The Office of the Defense Co-ordinator can be the temporary emergency center for the beginning of rehabilitation effort and continue in a coordinating capacity until plant departments are functioning normally again.

A comprehensive survey of damage should be made as soon as possible by all department heads. This will cover not only internal damage to structures, equipment, supplies and personnel but also damage outside the plant to transportation facilities, communications services, utilities and sources of raw materials which will hinder or prevent production.

When the damage survey is completed rehabilitation plans can be prepared.

While damage survey and rehabilitation planning is being carried on, emergency repairs can be worked on according to pre-attack plans.

First efforts should be directed toward protecting equipment from exposure to the elements by covering with tarpaulins, coating metal surfaces with grease, and laying down temporary roof coverings.

Debris should be cleared out from around machines and roadways, and dangerous structures made safe and repair work begun by Clearance Demolition and Repair Teams. (Chapters IX and X)

If employee morale has been high, friendly rivalry to be the first to get machinery into operation again may develop between departments, sections, shifts, and crews.

Naturally, unbalanced production is inevitable at first, but the sight of parts again coming off production lines may be worth all the trouble which may come later in getting inventory of finished parts into balance.

Improvisation will be the order of the day and primitive working conditions must be borne with such as rain, snow and cold coming through shattered windows, doors and roofs.

Once rehabilitation has been carried as far as circumstances permit, complete reconstruction plans can be prepared and application submitted to the government for whatever financial aid may be available.

And preparations begun for the next atomic attack!

CHAPTER XV

LONG RANGE PROJECTS

THIS CHAPTER will cover three long range industrial defense measures—*new construction, going underground,* and *industrial dispersion*—which require extensive planning and heavy investments of time, money, and materials, but which in the long run should provide better, and even more economical, protection than all the previously discussed measures put together.

New Construction

Any company which is contemplating plant expansion should give serious attention to the advisability of including protective features in the original building design.

Generally it is much easier and cheaper to include protective construction features in the design of an entirely new structure than it is to change existing structures in order to attain the same effect.

Here are some basic protective features to be considered in connection with new industrial construction:

- ability to survive blast and fire effects of atomic explosion within reasonable limits
- protection of occupants from blast, fire, thermal radiation, and nuclear radiation
- location as far as possible from probable targets
- arrangements for safe and rapid evacuation of building by employees
- built-in shelter space
- resistance to fire from atomic attack, including arrangements for ample on-site water supply
- minimizing hazards from bursting steam, water and gas pipes and containers, and from loose fixtures and ceilings, and flying glass
- separation from nearby structures by a distance equal to one and a half times building height
- provision for entry of utility lines and traffic from more than one direction.

Calculated risk must be considered in planning new construction, as in all industrial civil defense. For instance, it would be extravagant to attempt to attain one hundred per cent safety in construction of any building within one half mile of probable ground zero—except in those rare cases where the extreme criticality of a structure has been determined to be worth all-out protective measures.

Rarely should new industrial plants be built solely to improve atomic security. Rather, the problem of protective construction should be considered as an added element in the company's normal expansion plan.

Going Underground

Placing industrial plants underground undoubtedly would provide an extraordinarily high degree of protection against the effects of atomic explosion, but there are such marked disadvantages involved in underground operations that it would be justified only under special conditions. It is usually better to move a plant to a non-target area than to construct an underground factory.

Underground industrial operation has these advantages: (1) it is relatively easy to conceal the location of an underground installation; (2) with sufficient depth under earth and rock, installations are virtually impervious to atomic blast, heat, and radiation; (3) such construction provides safe and relatively economical dead storage space for records, spare equipment, jigs and fixtures and similar items, and it can be ideal for storage of emergency supplies, equipment and facilities, especially medical and fire equipment, which must be kept nearby but completely safe in the area of expected attack; (4) underground construction makes it possible to keep an industrial operation close to other related activities even though they may all be in a critical target area; (5) underground construction usually requires temperature and humidity control, but

once the equipment is installed it operates better in an underground location because there is no change in the temperature of the surrounding earth comparable to the change in temperature in the atmosphere surrounding an above-ground industrial installation; (6) maintenance cost is generally less for an underground installation than for an above-ground building.

The disadvantages of underground construction include (1) original investment two to three times as much; (2) underground work is psychologically depressing, with ever-present danger of panic; (3) there are serious technical difficulties in construction; (4) supporting services, such as power and water supply, must also be placed underground, otherwise they may be damaged by attack which would in turn effectively stop underground operations; (5) perpetual mechanical ventilation must be maintained; (6) underground construction is difficult to expand; (7) sound reverberations are disturbing and hard to control.

The practical solution for a plant contemplating the construction of additional space is to make a detailed comparison of the relative advantages and disadvantages of new construction in a non-target area and underground construction at the present site. The resulting data and insights should provide an objective and conclusive answer.

Industrial Dispersion

Space is the only completely effective defense against atomic explosion.

The nominal atomic bomb causes severe damage only up to one mile from ground zero and it is not expected that the super bombs, including the hydrogen bombs now being developed, will cause severe damage beyond ten miles from ground zero.

Thus it is clear that locating industrial plants ten miles or more from centers of expected atomic explosions will provide a very high factor of safety from physical effects of atomic attack.

The next question is: what are the expected locations of atomic explosions?

The A-bomb is an extraordinarily expensive weapon to manufacture and deliver on a target. Target planning groups make exhaustive studies to determine the most effective use of whatever A-bombs may be available for a particular tactical mission in comparison with other missions of the overall strategic plan.

As mentioned in Chapter IV the selection of target would be based on the strategic objective of doing maximum damage to our capacity for launching a full-scale counter attack, and targets would fall into two main categories:

(1) targets of peculiar military importance, and

(2) large industrial centers.

In 1950 the federal Government listed 150 "critical target areas." Naturally there is a vast difference in the relative "criticality" of these 150 targets ranging from "Target No. 1" to the last target on the list.

Industry in this country is rather concentrated geographically. Thirty-five prime target areas contain manufacturing facilities producing 56% of the nation's industrial product by dollar value.

"Industrial dispersion means locating facilities several miles apart. This creates many small unprofitable targets, not just one big juicy target. This will increase the odds for continued productive operation of essential facilities in the face of the most devastating atomic attack. Therefore industrial dispersion, in itself, is a defense measure in that any action which decreases vulnerability of targets increases security." [20-7]

Nationally considered this problem of industrial dispersion is much more urgent than might at first appear. In 1951 some 26 billion dollars was spent for new plant construction, as against an estimated 300 billion dollars replacement cost for the American industrial plant. A substantial portion of this new construction is being located in highly concentrated industrial areas making them even more attractive as A-bomb targets.

National Industrial Dispersion Program

In August 1951 the President announced a national policy for industrial dispersion which provides that defense supporting production facilities be located ten or more miles from potential target zones.

A *potential target zone* is an area which constitutes an attractive atom-bomb target because it contains highly industrialized or densely populated sections, or major military installations.

A *highly industrialized section* may be loosely defined as one in which there is at least one concentration of defense supporting plants within a twelve-square-mile-area each of which employs 100 or more workers and which together have a combined employment of 16,000 industrial workers.

A *densely populated section* may be loosely defined as one in which there is at least one twelve-square-mile area containing a population of 200,000 persons.

What constitutes a military installation worthy of attention from an enemy atom bomb cannot be made public. Some installations such as the atomic energy plant at Oak Ridge, Tennessee, are of such obvious military importance that civilian planners may safely

assume they are worthwhile targets. However, appraisal of this factor in other cases will be considered by military authorities in advising government agencies on the action to be taken with respect to applications from local communities and industrialists for governmental aids.

Every large community in the country should make a complete survey of its potential target zones according to the procedure set forth in the Department of Commerce brochure *Industrial Dispersion Guidebook for Communities.* [20-6]

The resulting report, including maps outlining potential target zones, will be made available to industrialists who plan on any sizable plant construction in the area.

To encourage industrial dispersion the Federal Government has established the following policy:

(a) to the greatest extent practicable, certificates of necessity, allocation of critical materials for construction purposes and emergency loans growing out of defense production will be confined to facilities which meet satisfactory standards for dispersion;

(b) primary consideration to dispersion factors will be given in locating factories built by the Federal Government;

(c) defense contracts will be awarded, and planning under Department of Defense production allocation programs will be conducted, in such a manner as to make maximum use of facilities located in dispersed sites. [20-7]

The most important single program for encouraging industrial dispersion is the granting of certificates of necessity permitting accelerated tax amortization (also see chapter VIII) based partly on determination of whether the proposed new plant is located in accordance with the government's industrial dispersion program.

Approval of direct loans (also see chapter VIII) as a matter of policy was to be based in part on whether the affected facility was located in accordance with the National Industrial Dispersion Program. While this policy has not been strictly enforced in the past, there is a trend toward tightening up on this activity as time goes on.

Information concerning local dispersion committees can be obtained from the field offices of the Department of Commerce.

Application forms for loans for facilities construction can be obtained from field offices of the Reconstruction Finance Corporation.

A manufacturer, in making application to the Defense Production Administration for a certificate of necessity can secure faster consideration of the dispersal phase if he attaches a statement from the local dispersion committee describing dispersal value of the selected site. If it is in conformance with the policy outlined above it should satisfy the Federal Government's dispersal requirements.

When a manufacturer proposes a location in an area where there is obviously no concentration of population or industry, and where no industrial dispersion committee exists, he can satisfy dispersion requirements by simply marking the proposed plant location on a road map of the locality and indicating the distance of his site from any nearby military installation, especially if the installation is within ten miles of the proposed site.

Effective dispersion does not necessarily require relocation to an entirely different region of the country. Frequently, the results can just as well be accomplished by a move 20 miles or so away, but in the same general area in which your plant is now operating.

Planning Corporate Dispersion

Now, how does the individual company adjust its plans to the National Industrial Dispersion Program when it is contemplating new plant construction?

First of all recognition must be given to a fundamental difference between military strategy and business strategy in selecting business location.

Our officially established military strategy calls for the dispersion of industry out of potential target zones in order that our military production capacity be protected and our military forces have available a steady flow of the material necessary to wage successful global war and thereby insure our survival as a free nation.

Sound business strategy calls for the placing of industrial enterprises in locations which will insure the profitability of business operations in a competitive free enterprise economic system. A business can die just as definite a death by trying to operate in a location which raises *delivered-to-consumer* costs above that of all competitors as though it were at ground zero under an exploding bomb.

While business strategy and military strategy have substantially different objectives they are not in fundamental conflict. Frequently the most profitable industrial location will be in a bomb safe area. The National Industrial Dispersion Program does not call for the wholesale relocation of American industry or even of any particular company but it does urge industrial management to give serious consideration to moving out of potential target zones and offers the various economic inducements previously mentioned, all of which tend to improve profitability of business operations in bomb-safe areas, thereby bringing into closer coordination the objectives of military strategy and business strategy.

In these circumstances individual corporate managements have a serious duty to their country and to their companies to make a most searching examination of the possibilities of locating new construction outside of potential target zones and then resolving doubts about location in favor of improving security against atomic attacks.

There are many sound economic reasons for locating plants away from heavily congested industrial centers. For many years there has been a pronounced trend toward decentralization of industry, aided largely by the vast improvement in transportation facilities of all kinds with the consequent spreading out of population and increase in the number of communities which can support industrial activity.

In beginning to think about corporate dispersion, it is essential to determine objectively just what effect geographical factors have on company growth and profitability.

With this frame of reference clearly in mind serious consideration can then be given to relative importance of the atomic survival factor in selecting an industrial location.

The lineup of factors to be considered might look something like this:

First, would it be better for your company to relocate or to decentralize, that is, would it be better to move the entire operation to a wholly new site or would it be better to establish an additional operating location?

Second, nature of long term growth. What is your business apt to be like ten years from now as compared with today with respect to sales volume, product lines, sales areas, raw material sources, manufacturing processes, capital requirements, and relative rank competitively in your industry?

Third, organizational structure. Has your overhead structure become so complex or so highly centralized that it has gotten too far away from the practicalities of selling in the field, shop management and the like?

Fourth, product divisions. Is your company trying to make basically dissimilar products at the same location with resulting headaches over raw materials, purchasing, production scheduling, standard labor rates, and the like? Would it be better to break off the newer, healthier, growing product line and put it in a new location where it can grow more freely?

Fifth, regional divisions. Many national companies have found that over-centralization has caused them to lose ground to smaller local competitors who have a keener awareness of local habits and preferences. Could your company improve its position by setting up a complete operation to serve a particular region?

Sixth, optimum plant size. For each industrial operation there is a certain size which produces highest average profit return for the amortized life of the plant. What constitutes "too small," "too big," or "just right" varies widely from industry to industry and from company to company. One heavy industry found that a plant of 8000 employees was "just right." In certain industries having little mechanization a number of companies feel that a plant employing 500 is the optimum size. The most efficient size can be determined only after a careful engineering study, including the development of reliable operating cost figures.

Seventh, sources of raw materials. Frequently production costs can be cut by processing raw materials close to the source of supply, avoiding unnecessary transportation costs.

Eighth, location of markets. Delivered-to-consumer-cost is the important end factor to consider here.

Ninth, labor supply and labor costs. Geographical differentials in labor costs are tending to disappear due to the trend toward national union organization and the spreading out of industry more generally over the country. But there is the keener question of availability of good grade labor. It is generally considered unwise to employ a preponderant share of the labor supply. Some companies will not enter a community where they will use more than 20% of the local labor force.

Tenth, executive personnel. Will a significant number of your higher caliber executive staff decline to accept transfer to a smaller community because of the absence of social, education, cultural and religious facilities?

Eleventh, human relations. Will a better intra-plant spirit develop because the total force is smaller and everyone can get to know everyone else?

Twelfth, atomic survival. This manual provides a basic check-list of the factors to be considered in analyzing the relationship between atomic survival and company location. By comparing the relative chance of survival in one location as against another it should quickly become clear how much weight this factor should be given relative to the other factors in determining plant location.

The problem of profitable plant location is deceptively simple at first sight but surprisingly complicated when analyzed in depth. Since most corporations are faced with the problem of site selection but infrequently, only the largest companies can maintain full time specialists on this highly technical management problem. In this case more than in any other area a company should consider drawing on the analytical skill, technical knowledge, and practical experience of professional management consultants before arriving at a final decision.

CHAPTER XVI

NATIONAL ORGANIZATIONS AND INDUSTRIAL DEFENSE

EVEN IN PEACETIME, the American industrial plant does not function by itself, but is dependent on a host of outside agencies which provide a multitude of services. These special agencies include trade associations, national and local business groups, professional societies, labor unions, business schools and research foundations. Each of these groups makes a definite contribution to our national economy in peacetime and now has special added responsibilities in connection with the development of industrial defense on a nation-wide basis.

Trade Associations. There are about 1,500 national trade associations in the United States, each representing the interests of the firms in a particular industry, or group of industries. These trade associations can serve their members in connection with the development of industrial defense in the following ways:

(1) keeping them advised of developments in the field of industrial defense which particularly affect their industry;

(2) sponsoring special research projects where necessary to develop solutions to defense problems which might not otherwise be available;

(3) representing the interests of their members before law-making bodies in connection with industrial defense problems;

(4) co-ordinating efforts of member firms in the field of industrial defense;

(5) securing public recognition for the accomplishments of member firms in supporting a national industrial defense program.

Each industrial group must study the problem and decide for itself the principal problems which it will be called upon to solve in case of atomic attack.

For instance, the machine tool industry will have to replace or rebuild a great deal of damaged industrial machinery after an atomic attack.

Chemical firms, especially those using continuous processes, are particularly vulnerable to A-blast and fire. Shielding can be extraordinarily expensive. The cost of relocation may be prohibitive. Accordingly, careful research is necessary to arrive at practical, economical solutions.

The transportation industry is not exceptionally vulnerable to A-bomb attack, because most of its installations are located at widely scattered points, and rights of way can be repaired with comparative ease. However, conditions immediately following attack will place unusual and heavy loads on all forms of transportation. Only the transportation industry itself is qualified to develop effective measures for meeting this problem.

Many public utilities are highly vulnerable to A-bomb attack and their services are vitally needed continuously during, and immediately after, an A-bomb explosion. Much excellent planning has been begun, but still more remains to be done.

Investment banking houses, and representatives of large capital holdings, must seriously consider the probability of atomic destruction in underwriting loans and investments of all types. This analysis should include not only the direct physical destruction of the property under consideration but the general economic effect on the investment if billions of dollars of asset value in American industry were destroyed overnight.

All branches of insurance should review their actuaria, their policy commitments, and their group underwriting arrangements to insure their own financial stability, and to provide maximum insurance protection to policy-holders and to the nation as a whole. If forty atomic bombs were dropped on American cities and each killed 25,000 persons who carried an average of $3,000 in life insurance, the resulting claims would total $3,000,000,000!

The $65,000,000,000 life insurance industry has already given considerable attention to this problem and tentative plans have been developed for a "pooling" agreement to cover war-catastrophe death hazards and spread insurance losses among the subscribing companies in proportion to their volume of risks within the home area. However, the plans drawn cover possible catastrophe claims of only $1,250,000,000 annually in addition to normal losses, which would probably cover some 400,000 policy holders deaths annually.

The larger retail trade establishments cannot relocate to any great extent and usually are close to centers of population. Accordingly, they have an exceptionally serious responsibility in protecting employees and customers who may be on their premises at the time of attack.

National Business Associations. National business associations, such as the National Industrial Conference Board, and the American Management Association have already distributed basic industrial defense information and no doubt will continue to do so.

Professional Societies. Professional specialists, such as lawyers, accountants, systems and procedures men, management engineers, consultants and industrial physicians, all must face new problems raised by the threat of A-bomb attack. Each professional society has the responsibility of studying what will be required of their professional members in developing defense of industry against atomic attack and then making available to them technical information and suggested solutions which can be used as a basis for providing industrial firms with professional advice in each specialty.

Labor Unions. Seventy thousand labor unions in the United States represent the largest single group of citizens interested in developing industrial defense. Their responsibilities include helping to recruit workers, training members of the industrial defense organization, and participating in actual planning and development of defense programs at each plant.

FCDA has announced the formation of a national Labor Advisory Committee which will advise the Administrator on problems concerning the protection of workers in the event of an attack and their participation in the civil defense program. The Committee consists of twelve members including representatives from the American Federation of Labor, Congress of Industrial Organizations, Railway Labor Executives Association, and Brotherhood of Locomotive Engineers.

Local Business Associations. There are over 24,000 business associations and associations of businessmen, throughout the country, most of them affiliated with national or international organizations. They have the all-important job of helping to determine how business in their area might be affected directly or indirectly by A-bomb attack and helping to develop an area-wide defense program, co-ordinating relationships between the industrial firms in their area and between industry and local civil defense authorities.

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(THE) OFFICE, 270 Madison Avenue, New York 16, N. Y. [24-9]

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OHIO CIVIL DEFENSE ORGANIZATION, Adjutant General's Office, Columbus 18, Ohio. [24-11]

U. S. GOVERNMENT. Write to Superintendent of Documents, Government Printing Office, Washington 25, D. C. for all publications listed under agencies of the U. S. Government in this reading list. [24-12]

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CIVIL DEFENSE RESEARCH ASSOCIATES, 475 Fifth Avenue, New York 17, N. Y. a national professional society for civilian and industrial protection, maintains an extensive collection of source materials on all aspects of civil defense and will answer inquiries on problems of industrial protection.

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MERVYN MOLLOY

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